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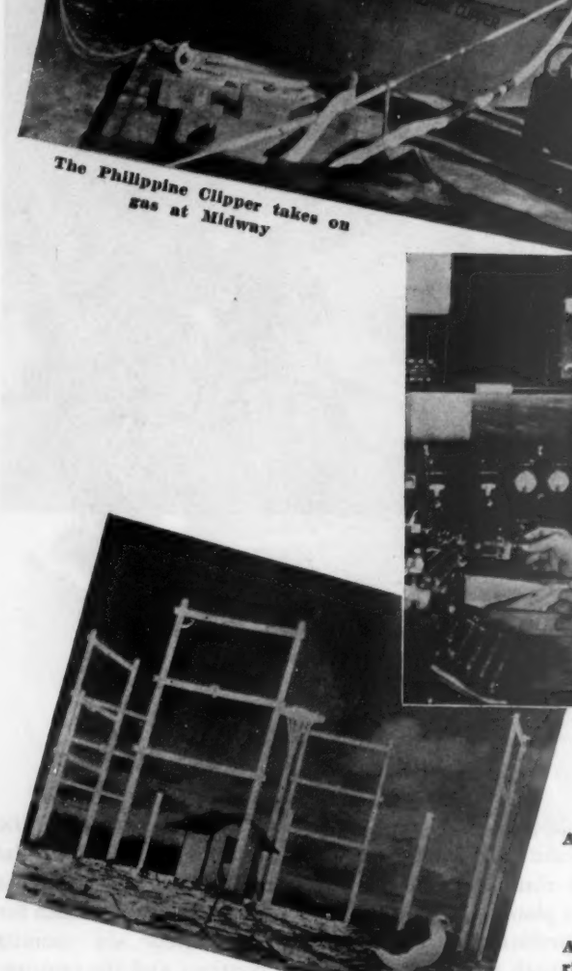
By Daniel Sayre
Pan American Airways

AFTER the great editorial and journalistic splurges that attended the opening of Pan American Airways trans-Pacific air mail service last fall and the inauguration of its trans-Pacific passenger service last month, it might seem there was little left to be written on the subject. However, between those two events intervened a period of operations about which little has ever been published. It was a period of pioneering, a shake-down period, a period in which a thousand technical aspects of one of the century's boldest enterprises had to be perfected in the crucible of half a million miles of transport flying across the world's widest ocean. It is of this period that we offer the following rather fragmentary comments.

For the sake of the record, it is possibly worthwhile reciting the actual achievement in crossings. November 22 of last year the China Clipper made what was not only the first round-trip with air mail but also the first complete flight of the route between San Francisco and Manila, the survey ship Pan American Clipper having penetrated only as far as Guam. December 9 the Philippine Clipper, which had just arrived on the Pacific Coast, likewise made a successful trip over the full route. As an entirely tentative working basis, it was planned to thus run two round-trips each month for a preliminary period of approximately six months although the terms of the mail contract and the requirements of the Post Office itself would have been satisfied under a considerably less rigorous arrangement.

The trouble started. On Dec. 22 the China Clipper, flying a Great Circle course toward Honolulu, was forced to turn back to Alameda because it had encountered head winds up to 45 miles an hour for almost its entire trip and winds of even greater force were reported ahead of it. For some days the wind conditions continued. Then Jan. 5, while taxiing out of the breakwater at Alameda for a check flight, the China Clipper struck a submerged obstruction that had been washed into the channel from one of the sunken hulks forming the breakwater, and had to be laid up in the shop for extensive repairs to its hull. Meanwhile a complete engine change had been started

The Philippine Clipper takes on gas at Midway



A typical mid-Pacific radio station

A gooney bird (lower right of picture) guarding the radio station at Midway

on the Philippine Clipper in expectation of the immediate arrival of the third ship, the Hawaii Clipper, from the factory at Baltimore. Now that the China Clipper was laid up anyway, it was decided to change its engines also. The plan however had been made without due regard for vagaries of the climate of Eastern America. One of the severest winters in Maryland history held the Hawaii Clipper ice-locked from open water in Chesapeake Bay for long weeks. Not until February 13th did a Clipper, once more the China, take off for a crossing. And then once more it was forced back by a repetition of the head-wind situation of December 22.

It was a string of disappointments that would have broken the hearts of a band of angels. Finally on February 22 the China Clipper got through to Honolulu and completed a reassuring on-schedule flight over the entire route. The Philippine successfully followed it March 18. Each ship made a complete round-trip in April.

Then in May the long-awaited and finally-arrived Hawaii Clipper was able to take up its share of the operations. Three round trips were completed in May, four in June, and four in July. Since that period a schedule of weekly departures from Alameda each Wednesday was set with the approval of the Post Office Department and run through without a hitch until early November when an extra survey flight from Manila to the Chinese Coast caused a two-day postponement of a scheduled departure.

So much for the trip-by-trip record. Together with the survey flights of the Pan American Clippers and routine test and training flights along the California coast, the actual mileage flown by the big ships over the Pacific passed the half-million mile mark early in October. After the mid-winter delays there was little more to mar the record. There have been two or three instances of minor motor difficulty—one considerable delay in Manila in the early spring awaiting engine parts to be forwarded on the following Clipper. There have been occasional delays on the Western end of the route of a day or two due to typhoons or other severe weather situations—more to the credit than to the debit side of the operation, since they were proof of the effectiveness of the system's typhoon watch in the Western Pacific.

The inauguration of air mail service had been hailed by the country's newspapers as a "final aerial conquest of the Pacific." Those familiar with the difficulties of pioneering any air transport system knew that it was nothing of the sort. There were so many things that still had to be worked out and perfected that it is almost impossible to even list them all in the space of a magazine article.

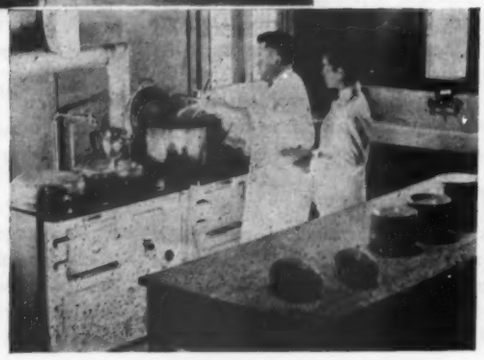
The big Clippers themselves were a new departure in aircraft design. Pilots have found that the low center of gravity resulting from the use of the lower hull and sea wings for fuel storage combined with the hydrodynamic qualities of the sea wings make them handle beautifully under all sorts of water surface conditions. Especially when being controlled by the Sperry artificial pilot they have proven very smooth riding in rough air. They have carried, on every one of their flights, within a few hundred pounds of their maximum rated gross load of 52,000 pounds through the whole operation. The engines, (800 hp. 14 cylinder P&W Wasps) after the first few months, have given very little trouble and carry the Clippers at good cruising speeds over the long California-Honolulu stage at slightly less than 50 per cent of power.

Maintenance schedules, of course, has been a major problem, with only three aircraft available for the task of flying weekly schedules over an 8200 mile airline. Under such a regime a ship leaving Alameda on a Wednesday arrives in Manila the following Monday night. The following Thursday morning it begins its return journey arriving in Alamada the following Tuesday morning at approximately noon. From Tuesday noon until the following Wednesday afternoon the big ships must be completely inspected and serviced. Two of the four engines are changed every three trips. The ship must undergo a long test flight on the Tuesday preceding each flight and a second one the morning of the day of departure. Even this brief overhaul period is cut down automatically by the full amount of any delay the ship may have experienced on its previous flight, since the character of the route prohibits make-up of lost distance en route. To match the task the maintenance department has posted experienced and skillful crews at each of the Island stations to give each clipper the full benefit of their attention at each mid-Pacific over-night stop. At Manila the Clippers are drawn out of the water and are thoroughly checked in a completely equipped nose-hangar. At Alameda itself the facilities have been planned down to the last detail to eliminate any lost motion whatever. A large force of mechanics is departmentalized and specialized in the work so that within an hour after a Clipper has arrived it is in the shop and being worked on by several dozen men, each going about a familiar and preplanned assignment. Pride of every maintenance man in the division are the four big working platforms, two at Alameda and two at Manila, that are moved under each wing to speed the work. No mere washing ladders these. Each is a complete and highly specialized workshop in itself. Their big top decks have work benches containing specialized tools, special recesses to fit around propellers and engines, electric and compressed air outlets, sumps for oil drainage and so on. Beneath are air compressors, tanks, compartments for cleaning equipment, even and literally a kitchen sink for the use of the men who specialize in keeping the Clipper cabins in spick and span shape. Through the year an ample maintenance

(*Turn to page 43*)

Pan American Airways Inn at Wake

Where Pacific wayfarers pass the nights



Culinary arts as practiced on a Pacific Island

With all the world building airplanes at a constantly accelerating rate, the S.A.E. could have selected no more interesting subject than production for its Pacific Coast Meeting. The high spots of the seven sessions are presented here.

DESIGN for PRODUCTION

The first of two reports prepared by Edward P. Warner

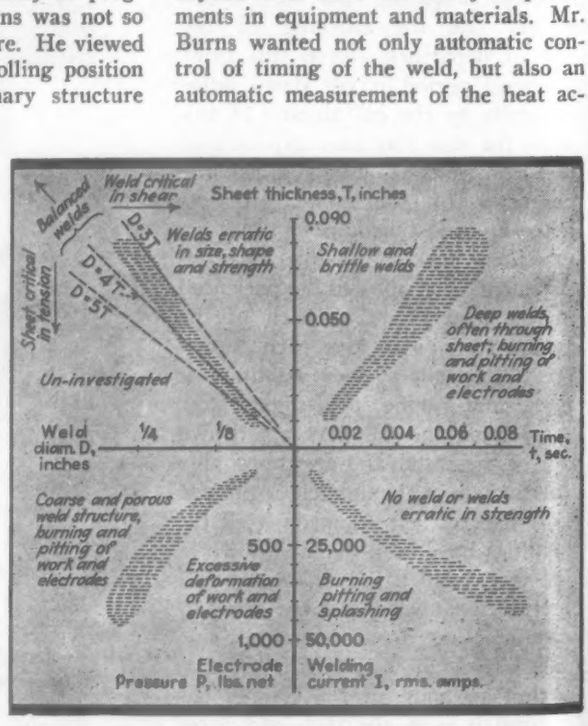
IF EVIDENCE were wanted to dispel for all time the ancient delusion that the art of airplane design consists of drawing pretty pictures with plenty of swish, the audience at the Society of Automotive Engineers' aircraft production meeting in Los Angeles provided it. They provided it by attending the sessions in numbers that fairly bulged the walls of the largest meeting rooms available; and by their respectful attention to papers that put the production man and his problem uppermost and that imposed upon the designer the primary responsibility of making it possible for production to be easy and economical.

There were seven sessions; there were fifteen papers; their authors represented seven factories, a research laboratory, two airlines, the Navy and the Department of Commerce; and their contents ranged from the specification of the oiliness of oils to the great problem of how to dampen a snorer's effect on his neighbors in a sleeper.

Spot Welding Secrets

The simon-pure production men grew most excited when Bruce Burns of Northrop took down the bars of secrecy around several years of private development of spot welding in light alloys, as Mr. Steward has done in AVIATION (for August, September, and October), and talked of welding practice and equipment. There had been plenty of progress in the past. Mr. Burns was not so sure of its rate in the future. He viewed its assumption of a controlling position in the assembly of primary structure with frank skepticism. So far as stainless steel became a primary structural element, spot welding would of course be the accepted production method. "If readily weldable aluminum alloys find their way into primary structure, or if new welding technique applied to present alloys satisfies necessary criteria, spot welding will here find an important place," but the *if*, twice repeated, was a large one.

Of the usefulness of spot welding in increasing the flexibility and economy of fabrication of light alloys for secondary and unstressed members there could of course be no doubt. To go beyond that calls for many improvements in equipment and materials. Mr. Burns wanted not only automatic control of timing of the weld, but also an automatic measurement of the heat ac-



Allowable range of weld characteristics in terms of sheet thickness.

tually developed in making it. The former is commonplace; but makers of welding equipment who discussed the paper gave little encouragement in connection with the latter objective. They dissented also from Mr. Burns' desire for a synchronized operation of two or more machines from a single timer. It could be done; in fact, it had been; but the manufacturers' best judgment was against it. Mr. Burns also made a great plea for improved electrode materials; which a representative of Westinghouse told him he could soon have.

Mr. Burns gave the roll type of welder, making either a continuous seam or an automatically spaced series of spots, more attention than it has generally received. Limited in application to straight lines and reasonably open sections, it allowed great speed, up as high as 1,800 spots per minute. Costs as quoted in this paper ranged more widely than the figures suggested by Mr. Steward in his articles, running as low as 0.01 cent per spot where a roll welder could be used and up to 3 cents at worst with the single-electrode type.

Particularly interesting was a chart in which Mr. Burns indicated allowable range of weld characteristics in terms of sheet thickness. It appeared, for example, that the diameter of a welding spot should be about three times the thickness of the sheet welded when the thickness approached ⅛ in., but rise relatively to more than five times the thickness where that was as low as 0.010 in. Though the properties of the weld and of the material must be reasonably controlled, as the chart showed, Mr. Burns was more casual about extreme rigor of welding conditions than some of his predecessors have been. He had welded successfully materials from 0.005 in. up to 0.125, and in connection with stainless steel, at least, he thought that recent metallurgical improvements "probably render them substantially free from carbide precipitation with any timings that are practical for use in production work." This is contrary to the view of some of stainless steel's foremost advocates, that absolute exactitude of timing is the first requirement for a successful weld.

Points brought out in the discussion, most of it coming from General Electric and Westinghouse, were that good voltage regulation was more essential than was sometimes recognized; that operation at 500 volts was superior to any lower figure; and that spots must not be placed very close together and then made in a straight serial order along the row, as they would contaminate each other. T. P. Wright, of Curtiss-Wright, urged the importance of spot welding for aerodynamic purposes, allowing complete surface smoothness. More optimistic than the paper's author, Mr. Wright thought spot welding "ought" to be ready for primary structure, having already served an apprenticeship under the unusually severe conditions imposed in rings and NACA cowls.

Left to right: Thomas Triplett, L. K. Steward, and Howard Houghton.

From France came Robert Boname to take notes at the sessions.

Theodore Woolsey and other delegates awaiting admission to sessions.

Savings by drop hammer

Howard D. Houghton of Douglas, George H. Prudden of Lockheed, and R. A. Von Hake, also of Lockheed, all talked of the relation of design to production equipment. Mr. Prudden told particularly of the range of usefulness of a drop hammer forming parts in soft metal dies. He recommended a female die of zinc cast directly on a plaster pattern, which in turn could be molded to form by hand under the designer's eye or scraped to form with templets made from drawings; and with a male die of lead poured directly into the female die of the mold, the difference of melting point of the two metals preventing sticking. Where dies were to be used for but a single set-up, pouring directly on the anvil of the hammer was recommended, the dies bedding themselves into the holes in the anvil and onto the bolts projecting from the upper head or hammer itself.

As an example of the production economy that results from the use of the hammer and dies so poured, Mr. Prudden cited a toilet seat made by hand that took 30 hours of labor, and wasn't much good then. The simplest of zinc and lead dies made it possible to replace the hand-made part with ten perfect and identical ones hammered out in a total of fifteen minutes.

In general, while "the drophammer cannot eliminate all other machinery, there is scarcely any forming operation in the manipulation of sheet metal that cannot be accomplished by the hammer." By its use "final assembly becomes a pleasure instead of a headache," but to prevent the hammer from causing more headaches than it cures it should be removed to the remotest corner of the shop, where the ears that must listen to its working will be few.

Mr. Houghton also sang the praises of the hammer, but with reference to forging of fittings rather than to forming of sheet. He thought welded steel fittings could be replaced to advantage in many cases by light alloy forgings, with saving of weight and elimination of electrolytic corrosion difficulties. A problem of forging under the hammer is the large draft angle required, not less than 7 deg., for removal of the part from the die; but that problem is solved, with the draft angle reduced to less than half a degree, by the use of hot pressings under enormous pressure. Both the die and the machine equipment for hot pressings being very

expensive, their use is necessarily limited to members that are to go into large production, and in general new production methods stress the importance of designing to use identical elements at as many different points of a given machine as possible. Mr. Houghton laid it down as almost a universal rule "that if a part can be machined from the solid for limited production, it can readily be converted to a forging for large production."

The Von Hake paper drilled upon the importance, of careful planning of factory, layout and tooling and upon the importance especially in a medium size factory of getting machines flexible enough to adapt themselves to many different jobs and to a wide range of working materials. Punch presses, drop hammers, and hydraulic presses were the most important of the specialized tools. With the factory once equipped, the author recommended that tooling be kept as closely as possible unified, with all jig, fixture, and tool design and storage handled through a central agency.

Ships with Queen Mary sized floats

In a session devoted to design in the broader sense, and not merely to its production aspects, J. K. Ball, chief of stress analysis for Boeing, presented a massive treatise on "Problems in the Design and Construction of Large Aircraft," written by R. J. Minshall, chief engineer, Fred D. Laudan, and Mr. Ball, himself. Boeing experience was reviewed from the 1929 Monomail, first of the stressed-skin commercial monoplanes, down to date. The authors declared their unwavering allegiance to the two-spar wing construction with good solid truss spars as against the multi cellular type. As they built still larger airplanes they would still use the same structural practices that they had approved over the past seven years.

Though they found large airplanes peculiarly difficult in some respects, notably in their low frequencies of vibration and consequent likelihood to resonance with forced periods, they found also some special advantages. In particular they expected large spars greatly to reduce trouble with stalling at the tips in highly tapered wings. Some of the aerodynamicists present doubted this and demanded proof not as yet forthcoming.

The authors opposed control of large airplanes through mechanical controlling gear totally separate from the controls themselves and recommended rather the use of servo tabs. Boeing had found these tabs very successful, and likely to be acceptable for all large airplanes now in sight. Several mechanism to increase braking power were also required and compressed air had been used, giving plenty of power but an inconvenient time lag. On the Boeing four-engined bomber the complaint against braking power had been of excess rather than of deficiency, as the wheels could easily be slid, with very bad results for the tires.

Structural design of the largest airplanes must be based more on rigidity than on ultimate strength. Boeing's practice preferred full truss members to the thin plate web used by other manufacturers in their wing spars; it employed tubular elements as far as possible; it kept the thickness of the outer skin of a wing at least half that of the corrugated material immediately underlying, in the interest of good torsional strength and to reduce wrinkles in the skin under stress. Another striking conclusion from Boeing experience was the conservatism of conventional methods of column calculation based on the yield point of material, for their tests indicated column strengths for steel tubes that followed (as the tube grew longer) a parabolic formula based on ultimate strength instead of yield point.

Another structural point especially critical on the large airplane was set forth in the necessity of analyzing spar chord members and skin stiffeners for the secondary stresses produced by the curvature resulting from the deflection of the wing as a whole; and another was the gust loading which might develop on the ground when an airplane was towed tail first around the corner of a building during a gale, or otherwise met the wind at an angle well calculated to tear the tail surfaces loose from their hinges. Moment coefficients of at least 1.00 for the elevator and 1.3 for the rudder were recommended to meet this last situation.

As an example of the decline of natural frequency with increasing size and its consequently increasing gravity as a design problem, figures were given for a number of airplanes. For a fin, for example, the natural frequency in a 3,000 lb. airplane was 1,750 cycles of vibration per minute. In a machine of ten times that weight it had fallen to 650 and the increased liability to resonance, other things being equal, would be obvious.

In conclusion, the authors observed that their title should have related to "larger" rather than to "large" aircraft, for they foresaw that the large airplane of today would be "but a stepping stone to airplanes of immense proportions." Fuselages of the present type would disappear and all equipment and load would be housed within the center section of the wing. They also believed "that the flying boat has no limitations as to size at the present time." This projection into the future led to a lively discussion, and to some prophecies of which the most romantic estimated that the Queen Mary would be just about the right size for a wing-tipped float on the future flying boat. Though one or two speakers thought there might be a limit to economical size, none of them was bold enough to attempt to set it.

The Boeing paper had advocated irreversibility of control, where it was mechanically possible, to prevent control circuit flutter. That started an argument from the advocates of dynamic balancing as a flutter suppressor. Dr. Klein of the California Institute of Technology thought irreversibility insufficient if applied only at the control arm, as the aileron or elevator could flutter in torsion within its own span. He believed in balancing both aerodynamically and dynamically by elements, so that each little segment along the span would be completely balanced within itself. British authorities were quoted as favoring both irreversibility of controls and dynamic balancing, finding neither one sufficient by itself. Mr. Ball found at least that balancing was not sufficient, as it could be valid with respect to only one particular set of axes.

Edward Burton of Douglas doubted any necessity of using servo tabs for controlling until the weight went well beyond 30,000 lb. He counted on accurate aerodynamic balancing to give light control by the ordinary direct linkages up to that point, or even higher. He issued the customary call upon engine manufacturers to produce power plants of higher unit output for these very large airplanes, and he disagreed by implication with his associate, Mr. Houghton, in suggesting steel castings for fittings, where Mr. Houghton had wanted to do away with steel and use light alloys throughout.

To a question about ground handling of large airplanes, Mr. Ball replied that there had been no trouble with the bomber when once on the ground, but some difficulty in landing because of the braking problems already referred to and the amount of sliding of the wheels that took place after contact before they were spinning at a proper speed with steady rolling.

Box car or Doge's palace

Arthur E. Raymond, chief engineer of Douglas, digressed from his printed paper long enough to express agreement with Mr. Ball and his associates at least on the impossibility of now defining any upper limit to the useful size of flying boats; but Mr. Raymond's paper was concerned more with passenger comfort than with overall size or

(*Turn to page 62*)

On Top

Airline operation up to 15,000 ft. now involves little difficulty. Beyond that point mechanical and physiological troubles multiply rapidly, but realizable economies are so attractive that many an air line is considering means of pushing operating ceilings up toward the 30,000 ft. level. Here is the record of TWA's high altitude research to date, by the man who has been doing the work.

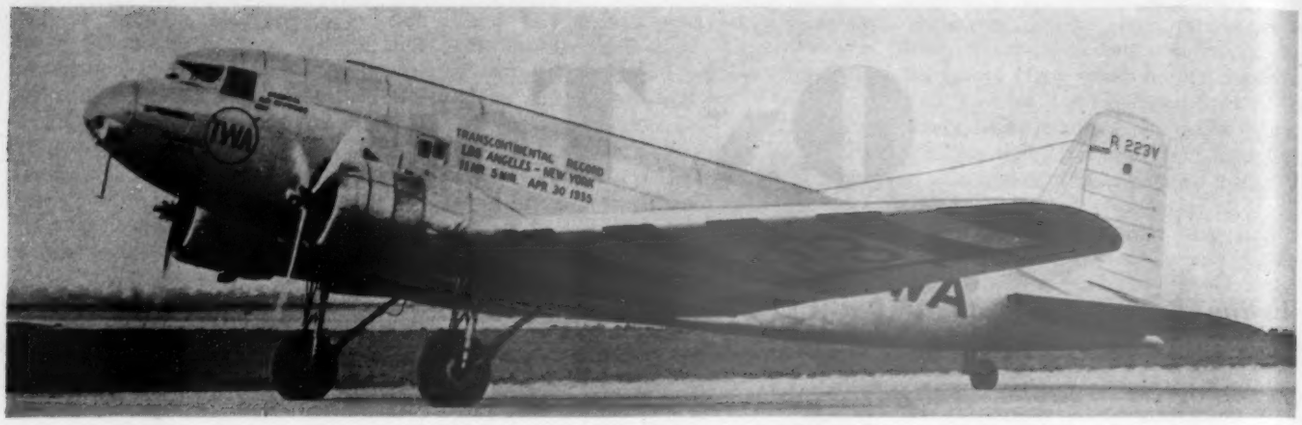
By D. W. Tomlinson

Assistant to the President
Transcontinental & Western Air Inc.

WHEN TWA decided to undertake an investigation of high altitude flying, two planes were available,—a single engine Northrop Gamma and "300", the bimotored DC-1, first Douglas transport to be built. The performance of either plane at altitude is approximately the same, but obviously the cost of operating the Gamma would be far less than that for the DC-1. The value of results obtained, however, lies in the completeness and accuracy of data observed during the flights. It is impossible for a pilot to fly an airplane manually with the great precision necessary in test work and, at the same time, observe many instruments and record data. The DC-1 was finally chosen because it could carry a crew sufficient to divide the duties of observing and recording data. Also as this plane is equipped with an automatic pilot, the pilot is free to handle the engine controls, a job which, in a large airplane on test flights of the nature contemplated, demands constant attention.

Since it was desired that the airplane be capable of operating with normal gross load (18,000 lb.) at 25,000 ft. or above (approximately the absolute ceiling for the DC-1 with Cyclone F-3 engines) a higher degree of supercharging was necessary, and two Wright Cyclone F-55 engines equipped with two-speed blowers, having a critical altitude in high speed blower ratio of 16,000 ft., were installed. These engines not only gave an absolute ceiling for the plane of about 30,000 ft., but also permitted cruising operation at constant power (1000 hp. total) from sea level to 20,000 ft. This was essential in order that data could be obtained to show the actual increase in velocity of the airplane with increase in altitude with power maintained constant, for comparison with the theoretical increase upon which predictions have been made concerning operation in the stratosphere.

In order to obtain best propeller and engine efficiency, Hamilton Standard controllables with constant speed governors were installed. (See AVIATION, September, 1936). The governors may be set to hold the engines at any desired r.p.m. and, thereby permit the engines to operate at maximum efficiency for any desired condition from full to cruising power. The counter-weight brackets which limit the pitch range were also changed to increase the pitch range to 20 deg. instead of the normal 10 deg. of the standard two-position type. The high pitch of the standard two-position propellers is 33¾ deg. In order to hold the engine r.p.m. within cruising limits at 20,000 ft. and above, the high pitch limit of the constant speed propellers



Pioneer upper air observatory—the Douglas DC-1.

was set to 38 deg., somewhat higher than actually necessary.

Mixture control

The combination of highly supercharged engines and constant speed propellers made it necessary to provide accurate means of controlling fuel-air mixture at altitudes in order to obtain either best power or best economy, as circumstances required. No automatic mixture control has yet been perfected which will take care of conditions above the critical altitude of the engine for cruising power. A survey indicated that the most suitable device available was one which, by means of a Wheatstone bridge, indicates the change of conductivity of a wire heated by the exhaust gases of the engine. The conductivity is dependent on temperature which, in turn, is dependent on the relative amount of CO and CO_2 in the exhaust gas. These two factors relate directly to the fuel-air ratio entering the cylinders. Thus, the galvanometer in the Wheatstone bridge may be calibrated to read directly the fuel-air ratio of the mixture entering the engine.

Another necessary feature was the use of a carburetor air pre-heat system which, in the low temperatures of high altitudes, would permit accurate control of the intake air temperature as well as insure freedom from ice in the carburetor. This was accomplished by installing a new system with two intensifier tubes, one on each section of the exhaust manifold, with the hot air inlets of the carburetor arranged on each side. Two valves were mounted in such a manner as to insure equal distribution of the heat to the four carburetor venturis. In order that accurate check might be made of carburetor conditions, thermocouples were installed over each venturi and a temperature bulb installed in the adapter between the carburetor and the supercharger impeller. These temperature gages were an addition to the usual temperature bulb in the carburetor air scoop. A connection was also provided in the carburetor air scoop for a Kollsman sensitive altimeter. The reading of this altimeter in relation to the plane's altimeter, determined the amount of ram. Thus all factors necessary for accurate determination of power under any conditions could be observed.

Early in the high altitude program the two vacuum pumps used for driving the gyro instruments had been connected in parallel in order to maintain sufficient vacuum above 20,000 ft. to insure dependable operation of the gyro instruments. Preliminary flights using only one pump had shown a loss of vacuum to the point where the gyro instruments and the automatic pilot could not be relied upon. With the two pumps in parallel, 5 in. of vacuum has been maintained up to 28,000 ft.

The Oxygen Problem

A major consideration was the supply of oxygen sufficient for a crew of four (pilot, co-pilot, observer and radio engineer) at altitudes above 20,000 ft. Oxygen can be obtained in two forms —gaseous and liquid. Liquid oxygen, compressed to 790 atmospheres, gives the largest amount of oxygen for a given container weight and capacity, but is subject to constant loss due to evaporation. It was decided to carry both forms, liquid oxygen as the main supply for use on long flights, and gaseous oxygen for short flights and as an emergency reserve when using liquid oxygen. A liquid oxygen container of 15 liters capacity was obtained. It was estimated that this supply would suffice for a crew of two for at least ten hours. The only vaporizer obtainable was one having an evaporating capacity sufficient for two men, but its output was increased to give the desired supply by directing the entire hot air blast from the cabin radiator against the coils of the vaporizer. This additional heat produced enough gaseous oxygen for a crew of four at 20,000 ft. and a crew of three at 27,000 ft.

Outwitting the dentist

Two gaseous oxygen containers of 38 cu.ft. capacity were carried, connected one at a time to the 4-outlet, manifold system in the cockpit. One of these tanks was ample for a crew of three at 20,000 ft. for approximately one hour. It was soon found that breathing cold oxygen gas directly from the vaporizer through the mouth resulted in the loss of fillings in the teeth due to contraction of the filling metal. To save on dental bills, the gaseous oxygen from the vaporizer was led through the coil around the steam pipe leading to the cockpit radiator and the temperature of the oxygen upon exit from the breathing nipples was brought up to 60 deg.

The output of the liquid oxygen vaporizer is controlled by a valve at the end of the relief line from the liquid oxygen container. A pressure gage is fitted on the line. By closing the valve and shutting off the escape of the oxygen which continuously vaporizes in the container, pressure is built up and liquid oxygen is forced up into the coils of the vaporizer. The rate at which the liquid oxygen is forced into the coils is governed by the pressure in the container. With the valve completely closed, pressure builds up to approximately 9 lb. Full pressure is required to produce enough oxygen for a crew of four but 6 lb. is adequate for three. Using this system the oxygen supply of the plane has been sufficient for upwards of three hours at altitude above 25,000 ft.

Much has already been written on the effect of oxygen deficiency on the human system. Our work with the DC-1 has not added a great deal to the fund

of knowledge in this respect, but several points are worth noting. In rapid descent from altitude after prolonged breathing of oxygen with the tube in the mouth, no popping of the eardrums or unpleasant adjustment of the sinuses to changes in pressure is noticed. Also, an experienced pilot suffering from lack of oxygen will continue to do a reasonably good job long after his mental faculties have suffered seriously. This is dangerous because he does not realize his loss in mental efficiency until called upon to solve a problem demanding original thought. A pilot with many thousands of hours flying experience, especially one who flies by instruments with the same ease as in clear weather, controls his airplane instinctively without mental effort. At altitudes where a non-instinctive pilot would lose control of his plane, due to the lack of oxygen, the instinctive pilot flies merrily along—although "dead from the ears up." The pilot who must reason his moves in controlling the airplane will lose control at much lower altitudes than the man who flies the plane without conscious effort. Perhaps some worthwhile research could be carried out in an altitude chamber with a device such as the Link trainer installed inside. The study of the effect of altitude could thus be put on a more practical basis than is now possible in rebreather tests.

Duties of the crew

On test flights the pilot flies the plane, handles the engines and controls the oxygen supply. He also keeps the automatic pilot adjusted, controls the engine r.p.m. with the constant speed governor controls, maintains the desired manifold pressure using the throttles, and keeps the mixture controls set properly using the fuel-air ratio analyzer as a gage. He wears a special mask in which a microphone is installed so that he can talk to ground stations without the necessity of removing the oxygen tube from his mouth. The co-pilot, seated on the right-hand side of the cockpit observes and records the following: indicated airspeed, carburetor air temperatures, oil temperatures, oil pressure, cylinder head temperatures, mixture ratio, vacuum, gyro-pilot oil pressure, fuel pressure, carburetor ram and fuel flow. Immediately behind the pilot stands the assistant observer who records the following: time, standard pressure altitude, outside air temperatures, engine r.p.m., manifold pressure, and other special data being recorded, such as exhaust manifold back pressure, pressures at various points in the engine nacelles, carburetor venturi temperatures and carburetor adapter temperatures. A radio engineer, when carried, operates whatever special radio equipment is under test and records pertinent data.

Navigation problems

Above 20,000 ft. accurate navigation by ground reference points is difficult. At extreme high altitudes it is impossible to tell with the necessary accuracy the time of passing over landmarks by simply looking out the window. In fact, on many flights at such altitudes, the cockpit windows are so encrusted with frost that the plane must be flown entirely by instruments. In order to observe landmarks a modified Gatty drift indicator is used. The fore and aft lines of the indicator have been supplemented by three athwartship lines—the middle one being at the center of the instrument. This enables an observer not only to determine the drift angle, but also to determine accurately the time of passage over a landmark.

Radio beams, and cones of silence do not afford sufficiently accurate reference points at high altitude for extremely accurate navigation. Cones of silence are found to lean one way or another away from the station of origin, and the beam legs suffer similar distortion. This is not serious in normal transport operation at lower levels. Radio reception, except when snow static was encountered, has been found excellent at all altitudes. Radio beams come in nicely and are used as check references on all flights.

Winds aloft

Few data are generally available for winds above 20,000 ft. Therefore, whenever practical, the winds at high levels have been studied by observation of ground winds, true airspeed and drift angle using the modified Gatty drift indicator. No extreme winds have been encountered. The direction at 25,000 ft. has been observed on various occasions to be west, northeast and southwest. In each case the direction of the wind was that to be expected from the pressure distribution at the time. On several flights the force of the winds above 20,000 ft. was materially less than the force at lower levels from the same direction. It has been concluded that the force and direction of the winds between 20,000 and 30,000 feet may be expected to follow generally the known laws of the winds in relation to pressure areas.

An interesting phase of the high altitude flying has been the operations over and through storm conditions at altitudes above 20,000 ft. The first high altitude flight of the DC–1 was from Kansas City to Detroit in July. Leaving Kansas City we climbed steadily to a 23,000 ft. cruising level. Approaching Goshen, Indiana, a large storm center lying to the east and centered approximately over Cleveland could be seen. The top of this storm at its western limits was at 20,000 ft. The clouds gradually rose to 22,000 ft. some 100 miles southwest of Detroit. To the east, domes protruded above the general cloud layer indicating local squall centers of near-thunderstorm proportions. The tops of these domes were estimated at 30,000 ft. The temperature in the clear air above the storm was 5 deg. F. Descent was begun about 50 miles west of Detroit. At 20,000 ft. indicated, with outside air temperature at 20 deg., heavy clear ice was encountered. It formed rapidly while descending through the layer from 20,000 to 17,000 ft. Below 17,000 ft. the temperature rose to 40 deg. and the ice melted rapidly. The solid upper layer terminated at 15,000 ft. below which the usual intermediate cloud layers were encountered. This appeared to be a typical summer storm condition not involving severe thunderstorms.

Operating out of Kansas City several severe thunderstorms were investigated. It was found that the anvil heads of

The new overweather laboratory.

such storms have their roots in the extremely turbulent clouds forming the general storm top at about 22,000 ft. The plane was flown directly through one such thunderhead at 26,000 ft. The temperature on the ground at Kansas City at the time was 100 deg. F. The temperature within the anvil head was 5 deg. F. The cloud seemed to consist of very fine snow and some water particles which froze and formed ice upon impact with the plane. Each water particle formed a circular ring of ice about ⅛ in. to ¼ in. in diameter, but no appreciable amount of ice formed. The air in the anvil head was apparently rising at 500 ft. per minute according to the rate-of-climb indicator. No descending current was encountered. The anvil head was traversed on a southeast heading (storm moving southeast) in about four minutes at a speed of approximately 150 m.p.h. Thus the distance through the cloud was about 10 miles. The upper overhang of the anvil head was toward the south. The under surface of this overhanging portion of the cloud was estimated to be above 30,000 ft. and the ultimate top of the storm probably reached to 35,000 ft., or into the base of the stratosphere. Observations indicated that the top of the turbulent clouds connecting the thunderstorms along the advancing wind shift line were at about 25,000 ft. at which altitude a plane could have just crossed the windshift line staying "on top".

On the flight of the DC–1 from Kansas City to Newark, in August, cruising for the most part at 27,000 ft. we had excellent view of the tropical hurricane which had moved up the east coast and was then centered roughly over Virginia and the Carolinas. The upper canopy or cirrus stratus cloud emanating from this storm extended over southern New York State. The top of this canopy was shaped like a great umbrella. The top at the center was estimated at 35,000 ft. Thin and tenuous at the outer fringe, this canopy of cirrus cloud thickened until it joined the turbulent lower layers at about 25,000 ft. in a vicious looking melee of angry air which appeared black, purple and almost green in places. This center lay about 150 miles or more south of the course of the plane to Newark. From this central maelstrom a lower layer spread out in all directions tapering downward from 25,000 ft. at the center to about 15,000 ft. over central Pennsylvania. This secondary layer became broken about 100 miles out from the center and disappeared entirely within another 10 to 20 miles. The DC–1 began descent through this secondary layer about south of Bellefonte. Intermediate layers and scattered clouds were found below 12,000 ft., which condition continued with intermittent rain the remainder of the way into Newark.

The wind over Indiana, Illinois and Ohio held steady at west 25 m.p.h. as the storm was approached. From western Pennsylvania, where the plane entered the influence of the storm the wind picked up to about 50 m.p.h. and became more northerly as the plane progressed eastward.

Where ice was found

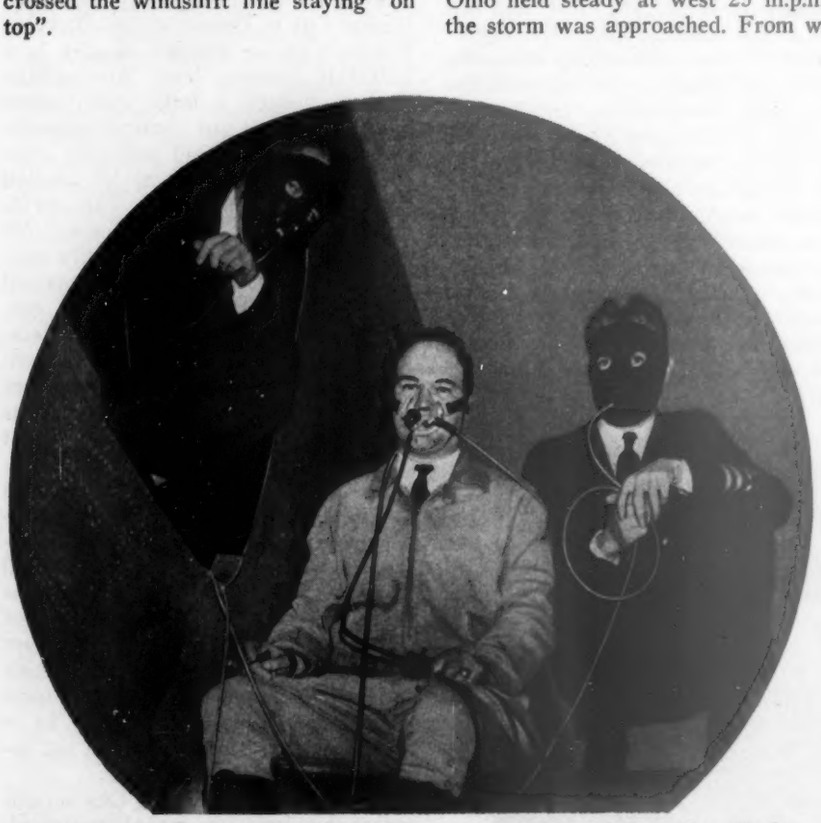
As a result of these observations it is concluded that severe weather conditions involving considerable turbulence and heavy icing may be found all the way up to the base of the stratosphere. In general, however, a plane cruising at 25,000 ft. can remain on top by making inconsequential detours. In a flight of 1,500 miles or over (half way across the continent) detouring 50 to 100 miles to either side of the direct course does not involve a serious loss of time.

With the sale of the DC–1 the high altitude program was continued using the Northrop Gamma equipped with a special Wright Cyclone engine and an exhaust turbo supercharger. Approximately twenty hours of flight testing at altitudes up to 35,000 ft. have been carried out using this airplane. The oxygen system with the Gamma parallels that used in the DC–1.

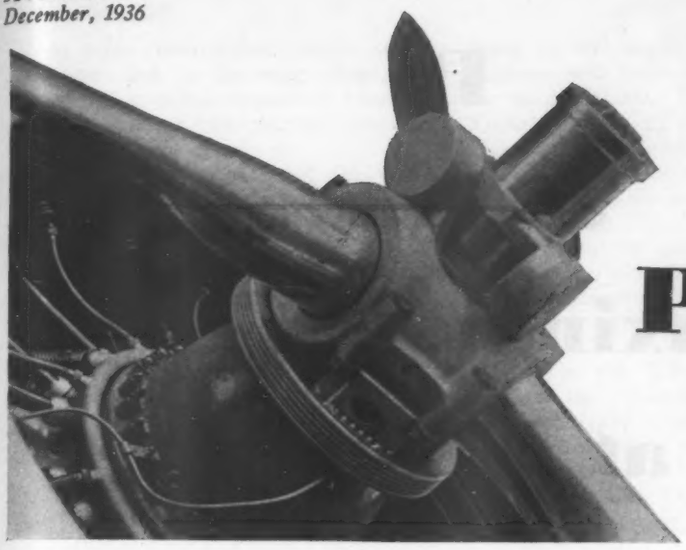
The Gamma carries a crew of two, a pilot and an observer. The observer rides in a cockpit just forward of the pilot's cockpit. In the observer's cockpit there is a complete set of engine flight instruments so arranged that data is recorded by photographing the instrument board using a Leica camera. The observer takes pictures at predetermined altitudes and later the films are developed and the actual data recorded from the films. This has been found to be the only practical way of obtaining a simultaneous reading of the 26 instruments.

Winds at stratosphere base

In order to accurately determine airplane speeds and the force and direction of the wind at high levels the plane has been flown around a triangular course from Kansas City to Kirksville to Columbia and return. This triangle is 336 miles. It is marked by radio beams which permits the course to be flown on instruments or on top. In this way the calculated speed of the airplane at altitudes up to 35,000 feet has been checked within two miles per hour of the true airspeed, reduced from the indicated airspeed. Wind velocities up to 60 m.p.h. have been observed under favorable conditions. It is proposed to fly this course while extreme winter storm conditions exist at low levels in order to determine wind velocities at the base of the stratosphere during these conditions.



Oxygen eaters ready for a flight. Left to right, Howard Morgan; the author; Harlon Hull.



Practical Uses of PROPELLER BRAKES

By Raymond B. Quick*
Bureau of Air Commerce

SINCE the introduction of propeller brakes on large multi-motored aircraft, there has been sufficient experience with them to make some appraisal of their value in practical operation. The utility of a device to stop an idling propeller almost instantly is two-fold. First, it provides an increase in performance with one or more dead engines. Secondly, it may be the means of saving a ship from serious structural damage in the event of certain types of engine or propeller failures.

At first, propeller brakes attracted manufacturers and operators as a means of increasing performance at high or service altitudes on twin-engine aircraft after the failure of one engine. Calculations and experience show, however, that on some twin-engine aircraft no increased altitude over that with idling propellers in high pitch will be obtained. In one test, when brakes were used on either engine of one of the large amphibians, there was no gain or loss of altitude, but a marked decrease in vibration.

There have been, however, several definite benefits resulting from the use of propeller brakes. There is an appreciable increase in speed in level flight when the propeller of a disabled engine is restrained from windmilling in high pitch. This was determined in tests made with the idling engine switched off and the propeller set in high pitch. It was found in specific instances, on one large four-engine flying boat, that locking one propeller instead of permitting it to windmill resulted in a marked drag reduction. One test indicated that the braked propeller permitted cruising at the same airspeed with 2.62 per cent less power than was required with the dead engine propeller windmilling. Translated into payload on a long range flight, the propeller brake provides weight allowance for at least one extra person.

The brakes also have been very beneficial for reduction of landing speeds. On recent tests with a large four-engine flying boat it was shown that there is considerable disturbance of air flow from windmilling engines, affecting the lift of the wing surfaces and the flow over the tail surfaces. With two inboard engines windmilling, a marginal condition of controllability existed during the glide and at the time of landing on the water. The range of stabilizer setting was from 4 deg. positive to 3 deg. negative from the glide to landing. With the same two inboard engines braked, there was a marked increase of control and the range of the stabilizer settings was from 3 deg. positive to only 1 deg. negative with a decrease in landing speed of 6-7 m.p.h. At the instant of landing the controllability was much more noticeable when the propellers were braked. In addition the tail surface vibration from disturbed airflow with windmilling propellers was completely lacking.

Controllability increased

Another important detail is the increase of controllability, longitudinally and directionally, when the windmilling propeller is stopped. Less rudder tab is necessary to maintain directional flight when the dead engine is braked and, as there is no disturbed or turbulent air over the wing, the lift of the wing area behind the propeller disk area is not impaired. Thus little or no aileron trimming is necessary to maintain lateral flight on an even keel. Therefore, when a landing is made at the destination desired after completion of a flight with a stopped engine, there will be an increased amount of controllability. This is especially true on aircraft using flaps as most of the flap areas are directly behind the engines.

In addition to these benefits, there is an increase in safety resulting from the use of propeller brakes. Even with a most profound respect for the products of our engine manufacturers we must be prepared for the unexpected. The safety of every airplane depends so much on minor factors, that it is serious to not consider any antidote that will save valuable equipment.

In trans-oceanic flights it is almost impossible to consider landing on the open sea, especially at night, for the purpose of making repairs to a disabled engine and it is imperative that the aircraft be able to continue flight after losing one or even two engines. Unless the disabled engine is completely stopped, disagreeable vibrations set up by the windmilling propeller or the unbalanced condition of the engine will be at least annoying to passengers.

The propeller brake has been considered favorably by all aircraft manufacturers, but the constantly increasing equipment which has become more or less required, has caused serious objection to anything that might augment the weight empty. The value of using propeller brakes is at present a matter to be decided on by the airline operator and the carrier of his insurance.

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*The development of propeller brakes, which I originally designed has been due largely to the valuable assistance of the Sikorsky Company and to the foresight of Mr. Igor Sikorsky. The writer also wishes to give due credit to Mr. J. Heron Crosman III for valuable assistance.

How FAST? II. Ultimate Maximum Speed at Altitude

The second of a series of articles discussing the upper limits of airplane performance. Future articles will cover range and ceiling

By

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and

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IN our first paper of this series, we presented a study of the possibilities of the high speed which can be obtained by racing airplanes at sea level. During recent years in air transportation, higher speeds and greater economies for the same power have been obtained by transport airplanes operating at altitudes over our regular air lines. It appears only logical therefore, that if we were to fly our racing planes at altitudes other than at sea level, we would be most likely to benefit and therefore to raise present record speeds. It is interesting to calculate the ultimate high speed which could be reached at any altitude by an airplane designed for ultimate performance at these altitudes.

Cost of speed at altitude

In the earlier paper, we gave the equation by which the high speed of an airplane in level flight could be calculated neglecting the effects of induced drag. This equation can be re-written as follows:

$$\overline{V} = 52.8 \left(\frac{\eta P}{f}\right)^{\frac{1}{3}}$$

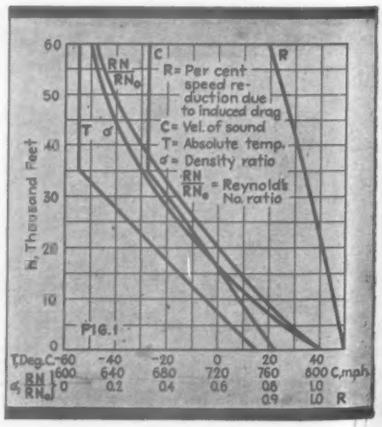
In order to make this equation applicable to high speed at altitude, we must consider two items: First, the effect of the decreased density in reducing the parasite drag, and second, the effect of the decreased density in increasing the induced drag which we considered to be negligible in the case of the racing airplane flying at sea level. The above equation then becomes:

$$\overline{V} = 52.8 \left(\frac{1}{\sigma}\frac{\eta P}{f}\right)^{\frac{1}{3}} R$$

where σ is the ratio between the density at the altitude considered and that at sea level ,and where R is the percentage by which the maximum speed is reduced due to the increasing effect of induced drag. In the first papers, the quantity $\left(\frac{\eta P}{f}\right)$ was called the "cost" of speed. It will be seen from the equation for high speed at altitude that, neglecting the increasing effect of induced drag, the "cost" of speed decreases in proportion to the density ratio.

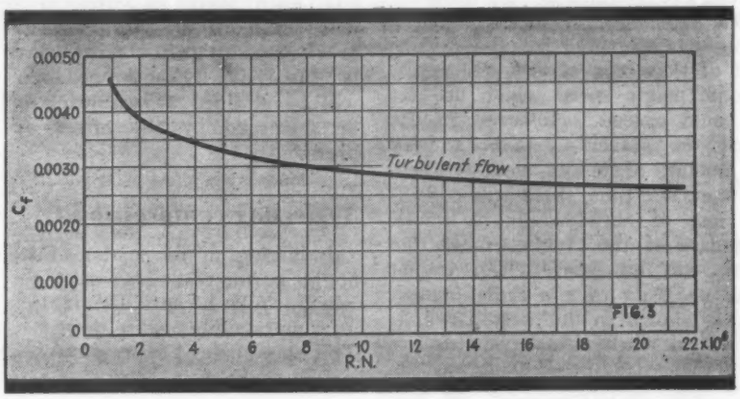
Effects of increasing altitude

In order to study the problem of high speed performance at altitude, we must consider three important factors. First, the one already mentioned,—decreased density; second, the increase in parasite drag coefficient due to the decreased Reynolds' Number; and third, the increased effect of compressibility. In Fig. 1, the physical variations of the quantities which control these three items are plotted against altitude. The density ratio was taken from that defined as a standard for the comparison of performance of airplanes and is given in N.A.C.A. Technical Report No. 218. A second item which must be considered is the changing scale effect with altitude which can be represented by the Reynolds' Number. The Reynolds' Number is the ratio $\left(\frac{\overline{V}L}{\nu}\right)$ where $\overline{V}$ is the velocity of flight of the airplane,



L is some characteristic length of the airplane such as the wing chord, and ν is the so-called kinematic viscosity, i.e., the ratio μ, the absolute viscosity, divided by the density ρ.

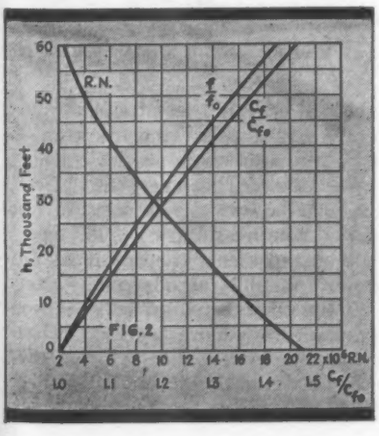
Assuming constant speed, the variation of the Reynolds' Number with altitude for a given airplane will depend only upon the variation in kinematic viscosity, ν. The results of this calculation are shown by the appropriate curve in Fig. 1 as a ratio of RN to RN_o, RN_o being the Reynolds' Number at sea level. The third effect, influencing speed at altitude, is the changing velocity of sound. The velocity of sound is proportional to the square root of absolute temperature, the variation of which is shown in Fig. 1 by the curve T, and is given in degrees Fahrenheit, absolute. Calculating the effect of the temperature on the velocity of sound, the last curve c, in Fig. 2, is obtained. c is the velocity of sound and is given in m.p.h.



Altitude and parasite drag

The relation between the ratio of Reynolds' Number at altitude to that at sea level has been given. Its effect on f must now be calculated. If we assume an airplane with a wing chord of 4 ft. flying at 550 m.p.h. at sea level, that airplane will have a Reynolds' Number of 21,000,000. This value is RN_o. From the ratio of RN/RN_o, given in Fig. 2, the Reynolds' Number at altitude may be calculated, assuming constant speed. This has been plotted and labeled RN in Fig. 2. This will not be *exactly* true for most airplanes, since the velocity will change with altitude, but is sufficiently accurate for our purposes, the approximation being very close.

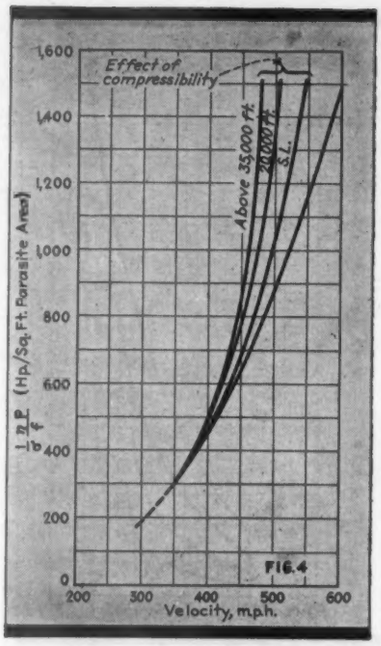
Dr. Th. von Kármán, in the first issue of the *"Journal of Aeronautical Sciences,"* gave a relationship between skin friction drag coefficient and the Reynolds' Number for turbulent flow, and the portion of this relationship which concerns us is reproduced as Fig. 3 in this paper. Using these data, together with the variation of the Reynolds' Number with altitude, the ratio of skin friction coefficient at altitude, C_f, to that a sea level, C_{fo}, can be calculated, and is plotted in Fig. 2.



Not all of the parasite drag of an airplane, however, is made up of skin friction drag. Part of it is a result of so-called form drag which depends only upon the form and size of the body and not upon its exposed area. This so-called form drag does not vary appreciably with the Reynolds' Number, and therefore, this variation will be neglected. For a very clean airplane about 90 per cent of the parasite drag is skin friction and the remainder, form drag. On this assumption the ratio of f, the equivalent parasite area at altitude, to f_o, the equivalent parasite area at sea level, can be calculated, and this relationship has been plotted in the curves of Fig. 2.

Sound velocity and speed

In our earlier paper, curves were presented giving the relationship between speed and the "cost" of speed, $\left(\frac{\eta P}{f}\right)$,



at seal level showing the added "cost" incurred because of compressibility. While we are considering performance at altitude, we must use what we might call the altitude "cost" of speed $\left(\frac{1}{\sigma}\frac{\eta P}{f}\right)$ instead of $\left(\frac{\eta P}{f}\right)$. Since the velocity of sound decreases with altitude as shown in Fig. 1, added "costs" will be incurred at altitude over those at sea level. This varying "cost" of speed, including the effect of the decrease in velocity of sound, is plotted in Fig. 4 in which the curve on the right neglects compressibility effects, and the other three curves give the effects of compressibility at the various altitudes noted on the curves. It is immediately apparent that as altitude is increased, limitations due to compressibility become much more stringent. Where a speed of for instance 575 m.p.h. would be the limit at sea level due to this compressibility, this limit would be reduced to 500 m.p.h. above 35,000 ft.

Induced drag

In the first section of the paper, an equation was given which included a factor, R, which represented the percentage to which the velocity would be decreased due to induced drag. It is usually thought that at the very high altitudes, induced drag would play an extremely important part. Actually in the case of racing airplanes this decrease is not as great as might be anticipated. It is impossible to calculate numerically the percentage of decrease in speed due to induced drag for all airplanes, since this factor is different for each airplane considered. There-

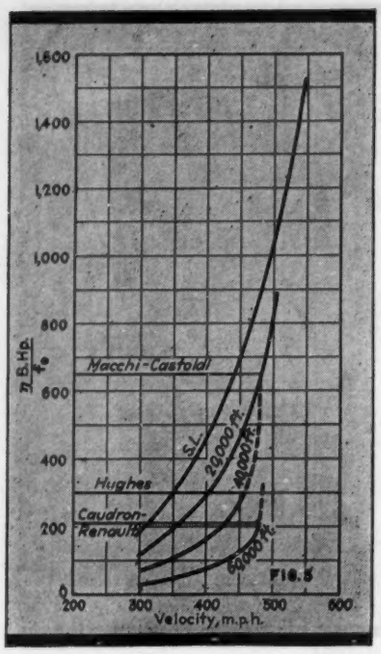


FIG. 5

fore, reasonable values were picked, based upon what might be considered to be an ultimate design, and variation of this factor is noted in Fig. 2.

Total "Cost" of speed at altitude

Incorporating the factors mentioned above except that of compressibility, Equation 2 may be written as follows:

$$\bar{V} = 52.8 \left(\frac{1}{\sigma}\frac{\eta P}{f}\right)^{\frac{1}{3}} \left(\frac{f}{f_o}\right)^{\frac{1}{3}} R$$

If the value of $\left(\frac{\eta P}{f}\right)$ (thrust hp./sq.ft. of equivalent parasite area at sea level) is plotted against speed for the various altitudes, in every case reducing the speed in proportion to the effect of the compressibility, Fig. 5 is obtained. It becomes immediately apparent from this figure that as higher and higher altitudes are obtained, the "cost" of that speed becomes considerably reduced, but the maximum obtainable speed by any means whatever will also be reduced. In this figure are noted the three racing airplanes referred to in our first paper, so that the advantage which might be gained by going to altitude can be determined.

It is of interest to plot the percentage increase in maximum speed against altitude for each of these three planes. This has been done in Fig. 6, and the result is extremely interesting. In this figure, the solid lines are calculated values and the dotted lines represent a reasonable extrapolation of the solid curves to higher altitudes. Assuming constant thrust horsepower available, the extrapolations of these curves then, show the maximum possible limits to which these three racing planes could be extended from the standpoint of speed. Along each of the curves are noted the values of $\left(\frac{\eta P}{f_o}\right)$ and also the speed obtained at the peak of these curves. The most interesting feature of these figures is that all three of these airplanes, so different in design, would have maximum possible speeds within 20 m.p.h. of each other, assuming, of course, that the thrust horsepower might be maintained independently of altitude and without increase in the equivalent parasite area. This, of course, is a very doubtful assumption at the very high altitudes, but there is reasonable assurance that by means of exhaust driven superchargers, it might be obtained at reasonably high altitudes. The maximum speeds for the three airplanes, of course, are obtained at very different altitudes.

It might be supposed from the examination of these curves that 500 m.p.h. was some magic speed which no airplane could exceed. However, in the case of the Macchi-Castoldi, a very great amount of power was obtained, but at the same time, there was considerable loss of aerodynamic cleanness. In the case of the Hughes racer, the airplane was extremely clean except for the necessity of the radial motor, which, as shown in our first paper, is not practical when ultimate speeds are desired. The Caudron-Renault was extremely clean aerodynamically but had a comparatively small amount of power available per unit of frontal area. Thus if each of these three airplanes could combine the desirable features of the others, a definite increase of the maximum speed could be attained.

It is apparent from the last figure that as the record speed at altitude goes up, the altitude at which it will be attained will be decreased thus, leading to the obvious conclusion that the ultimate high speed at any altitude will be attained at sea level in accordance with our first paper. This does not mean, however, that records will not be broken by flying at altitudes above sea level. At the present state of high speed records, namely, 441 m.p.h., it is considerably less "costly" to attain greater speeds by increasing altitude, as shown by Fig. 6, than by increasing $\left(\frac{\eta P}{f}\right)$ at sea level. Therefore, except for the complication introduced by racing rules governing the official recognition of such record speeds, the next step is to fly these same airplanes with additional supercharging, or cleaner and more powerful airplanes, at higher altitudes. Although the altitudes at which the ultimate speeds of the three racing planes would be attained are rather fantastic and probably impossible with the present form of power units, none the less, even small increases in altitude will result in an increase of speeds previously attained. However, in a last analysis, the ultimate high speed will be attained at sea level and will be governed by the effect of compressibility.

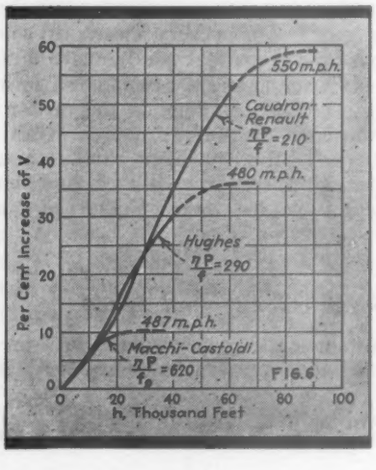


FIG. 6

Neglecting compressibility

Indulging in the realm of fancy, it might be interesting to calculate speed which could be attained if the effect of compressibility were to be neglected. This speed can be expressed by the very simple equation

$$\bar{V} = 332.4 \frac{\eta P}{W} \frac{b}{\sqrt{f}}$$

in which ηP is the thrust horsepower available, W is the weight of the airplane in pounds, b is the wing span in feet, and f is the equivalent parasite area in square feet. V is given in m.p.h. This equation merely gives the speed which could be attained at the altitude at which the plane was flying at the maximum lift/drag ratio. In the table below, values of V for the three airplanes are noted together with the altitude at which these speeds could be attained. Here again it is assumed that the power could be attained independently of altitude, and of course, fantastic altitudes result in the calculation. We can see, however, the "price" which must be paid as a sort of tax levied by compressibility. The equation above represents the result of the maximum possible aerodynamic economy. This same equation will be used to advantage in a more practical calculation in the next paper which deals with the maximum range and endurance, in which economy is the key note.

Plane	Ultimate Speed Neglecting Compressibility	Altitude (Approx.)
Hughes	640 m.p.h.	80,000 ft.
Caudron - Renault	705 m.p.h.	120,000 ft.
Macchi - Castoldi	1370 m.p.h.	

Thin-Walled STRUCTURES

By F. R. Shanley

Manufacturing Inspection Service Bureau of Air Commerce, Washington.

The author of last month's article "Pounds or Pounds per Square Inch" continues the interpretation of modern forms of construction on a weight-strength basis and gives us his view on future trends.

MODERN designers are concerned with two general types of failure, which were designated broadly in last month's article as "stress" failures (Type I) and "stability" failures (Type II). Considering different shell types of structure of the same diameter and cross-sectional shape it was found that the *weight-strength* factors (strength being held constant) for the two limiting types of failure were given by the following equations:

$$(W/S)_I = C(w/F) \quad \ldots\ldots\ldots \quad (1)$$

$$(W/S)_{II} = C(w/\sqrt{E}) \quad \ldots\ldots \quad (2)$$

In these equations w is the unit weight or density of the material, F is the failing stress (ultimate or yield, as the case may be), E is the well-known modulus of elasticity which is a measure of the stiffness of the material, and C is a constant used to denote proportionality. In deriving equation (2) another useful equation was found, namely:

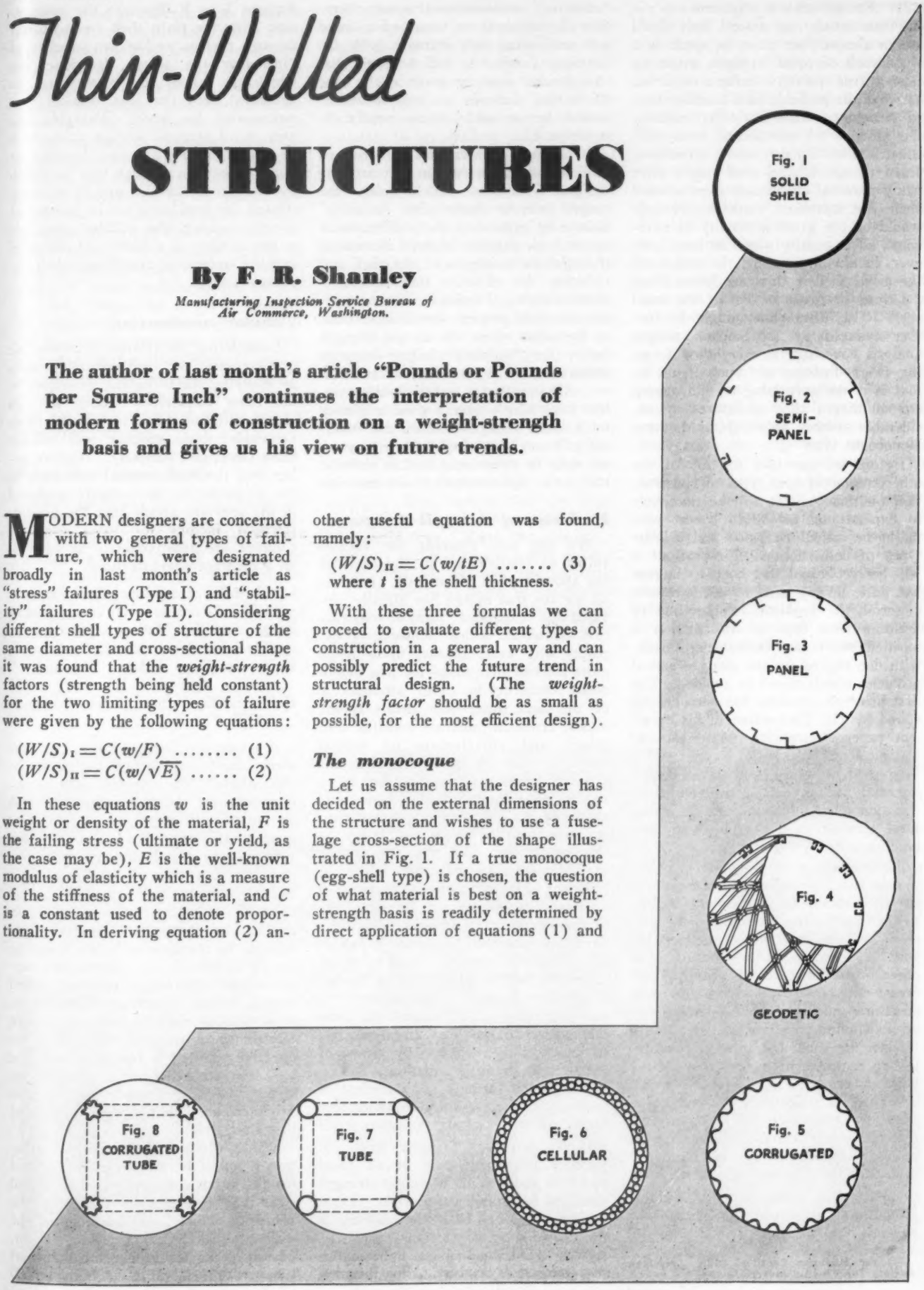
$$(W/S)_{II} = C(w/tE) \quad \ldots\ldots\ldots \quad (3)$$

where t is the shell thickness.

With these three formulas we can proceed to evaluate different types of construction in a general way and can possibly predict the future trend in structural design. (The *weight-strength factor* should be as small as possible, for the most efficient design).

The monocoque

Let us assume that the designer has decided on the external dimensions of the structure and wishes to use a fuselage cross-section of the shape illustrated in Fig. 1. If a true monocoque (egg-shell type) is chosen, the question of what material is best on a weight-strength basis is readily determined by direct application of equations (1) and



(2). For instance, it was shown in the previous article that a steel shell would weigh almost four times as much as a wood shell of equal strength, assuming that a true stability failure occurred, as would be probable in a fuselage type of structure. This obviously explains the absence of unstiffened steel shell construction among such structures. Even though a steel shell might offer many practical advantages over a wood shell the increased structural weight would be too great a penalty to overcome. The penalty would be less, however, in aluminum alloy, the weight of the metal shell in this case being about 2.3 times as great as that of the wood shell. This discrepancy might be further reduced by a complete weight analysis covering the weight of forming rings, fittings, and such items, so that it is not surprising to find among our aluminum alloy structures a considerable number approaching the true monocoque type.

Before we can take up any of the other commonly-used types of construction on this basis it will be necessary to expand our theory to cover what might be called the *panel* and *cellular* types of construction. First of all it will be recognized that once a designer has made up his mind to use a certain material, the problem becomes one of deciding what type of construction is most efficient on a weight-strength basis, with due regard for the many practical problems which cannot be avoided. The first principle involved has been clearly stated by Dr. Tuckerman in his excellent paper, "Aircraft: Materials and Testing"[1] in which he says: "This (requirement) consists in spreading the material as far out as possible from the axis of the structure or its structural elements and at the same time holding it firmly together."

The second principle might well be a rule that the *effective thickness* of the shell should be made great enough so that the failing strength of the material will be substantially utilized before a stability failure occurs. In other words, we can theoretically increase the "stability" strength of a structure indefinitely by spreading out or expanding the material so as to thicken the shell, but it would be useless to continue this process beyond the point where a "stress" failure would occur. This process of thickening the shell by expansion of the original material simply amounts to reducing the *effective* value of w in equation (2) more rapidly than we reduce the value of $\sqrt{E}$, thus decreasing the weight-strength factor. (In this method of analysis we base all properties on the "effective" cross-sectional area: therefore E, which is in terms of a force per unit area, will decrease with increasing area). It will be seen that this process does no good in the case of "stress" failures, as both w and F would be reduced proportionally in equation (1).

It can now be seen that all forms of stiffened shell construction represent the designer's efforts to decrease the *weight-strength* factor for "stability" failure by expanding the shell material as much as possible, thereby increasing the *effective thickness* of the shell and reducing the effective unit cross-sectional weight. To obtain maximum efficiency, this process should be carried to the point where the *weight-strength* factor for "stability" failure becomes about as good as that for "stress" failure. Obviously, for materials like stainless steel which have a good efficiency on a stress basis but which are inherently "heavy", the shell-thickening process must be extensively used in order to utilize the high strength of the material.

Evolution of thin-wall structures

We can now examine the various forms of construction in the light of the above method of analysis. First of all we see that nature has already provided this "expanded" form of construction in wood, which immediately explains why wood appears to be much more efficient than metal for true monocoque construction. Our attempts to do the same thing with metals appear almost crude in constrast with the simplicity and effectiveness of natural methods. Yet we have arrived at our present forms of construction by a process of evolution infinitely more rapid than nature's. Not so long ago stiffeners were regarded simply as aids for the skin or plating. We now realize that the stiffeners are usually more important than the skin in carrying compressive loads and the tendency is to regard the skin as aiding the stiffeners. Even the formulas used in modern stiffened-panel analysis reduce the skin to an "effective width" which can be considered to be as good as the stiffener in carrying load. The expert in these methods of analysis may find it possible to interpret the formulas by means of the weight-strength equations, by regarding such formulas as a method of transposing the "stability" equation into terms of the "stress" equation. (It may be significant that the term $\sqrt{E}$ plays a prominent part in all panel problems and also in the weight-strength equation for stability failure.)

There seems to be a sort of cycle in the development of airplane structures, if we regard them in the light of this new method of analysis. For instance, Figures 1 to 8 illustrate the progression from the plain shell (monocoque) through various well-known panel types (including the recent "geodetic", in which the panels are constructed diagonally) into the true cellular type represented by wood. Carrying the idea to an extreme we can even think of the steel tube type of fuselage or wing beam as a cellular type in which the number of cells is greatly reduced. Almost any panel type can be thought of as approaching the cellular structure as the number of stiffeners is increased and the amount of unstiffened shell approaches zero.

Tubular construction

Considering the tubular structure, we can continue the evolutionary process by applying the foregoing principles to the tubes themselves. Thus we can obtain stiffened tubes, corrugated tubes (example: drain spouts), and cellular tubes (example: bamboo). Without going into the mathematical derivation it can be shown by the methods employed in the previous article that the *weight-strength* factors for tubes used as columns are approximately as follows, on a constant-strength basis:

Local stability failure (diam. const.): $w/E^{1/2}$ ..... (2)
Local stability failure (t const.): wD/E ..... (4)
Euler stability failure (L and D const.): w/E..... (5)
Euler stability failure (L and t const.): $w/E^{1/3}$ ..... (6)

A complete interpretation of the above factors is beyond the scope of this article. The engineer will recognize, however, that the modulus E plays an entirely different part in different types of stability failures and with different geometrical limitations. For instance, equation (6) indicates that Euler columns built for the same strength and having the same wall thickness and length would be relatively little affected by changes in E, but would be greatly affected by w. Under such conditions the light-weight materials would have a decided advantage. Conversely, steel columns might be made much more efficient by an artificial reduction in the effective value of w such as is obtained by corrugating the walls. British designers have long made use of this principle in building wing beams of thin steel strip.

While discussing tubular construction it might be well to point out that the D/t ratios commonly used in welded steel tube fuselages lie far below the values at which local buckling of the walls might be expected to occur. Theory alone would indicate that steel tubes with D/t ratios as high as 500

[1] Edgar Marburg Lecture, 1935, American Society for Testing Materials.

could be used as columns with complete freedom from local buckling. Since present practice stops somewhere around 60, it seems obvious that there is a large field for exploration. Remembering that for greatest efficiency the structure should be designed so as to utilize all the mechanical properties of a material, it would seem that steel's high modulus of elasticity (E) has been somewhat neglected in the past. Another view of this problem is obtained by considering that the strength of an Euler column of constant length is very closely proportional to EWD^3, where W is the weight of the column material. Thus, for a given strength the weight will decrease very rapidly as the diameter is increased. There will, of course, be practical limits to such a process, such as minimum wall thicknesses, welding technique, etc., but these may not be so important as the size of structures increases.

What the future holds

Since designers are fully aware of the practical advantages and disadvantages of most common forms of construction no attempt will be made to place a final efficiency evaluation on any of the present types. Such an attempt would have to consider features such as local loads, fabrication, joints, cut-outs, stiffness, combined loadings, and other practical features too numerous to mention. Predictions as to what materials are likely to be most used in the future would be somewhat hazardous, if for no other reason than the fact that an ingenious engineer can usually find some way to use any structural material in an efficient manner, if he understands the fundamental types of failure. It seems reasonable to predict that a healthy competition will continue to exist between the present steel tube, aluminum alloy, and stainless steel forms of construction, as each has certain advantages which cannot be overlooked.

Among the various types of construction represented in the accompanying figures one of the mose promising appears to be the cellular (Fig. 6). Such cellular material might be artificially reproduced from metals, plastics, or combinations of various materials. The case for plastics appears particularly promising in view of the previous disclosure that a high value of E is not as important as a low value of w (unit weight). The engineer will also think of the sound-proofing qualities of cellular structures. Even the use of a relatively soft material as a core or filler would tend to improve the strength, if a suitable bond could be maintained between filler and skin. Nature's example of this is found in the alder stalk.

For the stress analyst the use of an "effective" thickness to represent the different types of stiffened shell construction might offer a possible method of attack on the problem of general instability of shells. Such failures can occur if the stiffeners are made too flexible. This problem will have to be faced if we hope to build our very large structures on an efficient weight-strength basis. Those interested will find the British Air Ministry R. & M. No. 1679, "Stability of a Monocoque in Compression," by J. L. Taylor, to be helpful.

We seem to be on the threshold of a new and clearer understanding of the structural engineer's problem of transmitting loads from place to place with the least possible structural weight. With such an understanding we can expect to see considerable reductions in "necessary" load, with corresponding increases in payload. And last (but not least from the engineer's standpoint) we can hope for a reduction in the headaches which have been brought on by the coming of the thin-walled structure and the rapid growth in the size of airplanes, both of which have combined to produce what Dr. Tuckerman has aptly called "a field of enormous complexity involving the geometrical properties of the most varied cross-sections, combined with the elastic and other properties of the material."

★ ★ ★

Bachelors Quarters. Building for unmarried pilots at Hamilton Field, San Rafael, Calif.

Editorials

AVIATION • ESTABLISHED 1916
VOLUME 35, NUMBER 12

INSULATION

▶ This is not an essay about a string and rubber covering for electrical conductors. It concerns rather the literal meaning of the title—or the state of being an island.

Islands may be real, or they may be creations of the imagination. Real or imaginary, however, the advantages gained from living on them are directly proportional to the protection afforded the inhabitants by the surrounding medium—be it air, water, or a state of mind—against unwanted outside contacts.

England, for example, was once an island. Until recently the narrow strip of water that separates the British Isles from the mainland was a fairly efficient insulator. Because of it, England has been able to throw her weight on the scales of European politics more or less as she saw fit. But with the rise of air power the situation has changed completely. As an insulator the twenty odd miles of Channel have become almost as effective as a strip of wet paper between the terminals of a million volt transformer. England is an island no longer—and she has suddenly become acutely aware of it.

So far, we have been in Europe only long enough to form some general impressions. Chief among them is a feeling of thankfulness that we live in America at this period of world affairs. Not that we have any special pride in our history or in our achievements. Comparatively speaking, we have no history, and certainly, many a European nation handles many of its social problems far better than ourselves. But we have seen an England with "the wind up" working night and day to build up aerial defenses before it is too late. We have seen a rearmed Germany with thousands of efficient aircraft in being and in production—with her city streets crowded with uniformed youth on fire with zeal to restore the Reich to a world power. We have watched the turn of events in Spain and we have listened at close range to the rumblings of the Russian Bear in the east and of the French social volcano across the Rhine to the west.

Small wonder then that we look with considerable comfort to the two thousand-odd miles of ocean that separates us from Europe. Actually, for the present stage of aeronautical development at least, America has taken over England's island position. We are almost the only truly insular nation left in the world today, and until both European and Asiatic affairs acquire a much greater degree of stability than they exhibit at the moment, *Gott sei dank!*

Berlin, Nov. 10.

WINTER AT THE AIRPORT

ALL over the country (excepting Florida and California) fixed base operators at the smaller airports are moving into the dull winter season, after one of the best years they have had since 1929 or 1930. Some are closing up their airports and going into other work. Others are resigning themselves to a cold, lean winter. Both may be making a serious mistake.

There are times when closing an airport for the winter is the only sensible thing to do. We do not propose that you spend several hundred dollars for snow removal to take up a dozen passengers at a dollar a head. But there is no reason why many of the fields abandoned when the mercury goes below freezing do not remain active during a large part of the winter.

If you need a non-aeronautical job to keep the wolf from the door in winter you almost always have your weekends to yourself. Each winter weekend there are hundreds of red blooded youths who go forth in search of winter sports, and are willing to pay for them. Your job is to divert some of that income from the promotors of ski-train parties, skating rinks and similar enterprises. Maybe you will have to flood an unused portion of the field to make a place for ice skating. If your buildings are well heated and otherwise suitable, a series of Saturday night hangar dances will bring in some revenue if they are effectively promoted. An airport New Year's Eve celebration could be made to pay big profits. Clubs and church societies are constantly seeking novel ways to keep members supplied with recreation. Such non-aeronautical activities serve to focus public attention on the airport, to establish it in the public mind as a recreational center. The rest is easy.

Offer special flying rates to members of the skating or dancing parties. Organize Saturday afternoon and Sunday trips to the airport for selected groups. And without any doubt your winter weekends will pay you very convenient dividends.

BUYERS' HOLIDAY

PRODUCTION of airplanes, engines and accessories is going up. Everywhere we hear of new highs. One manufacturer is planning to build a thousand airplanes for which he will buy a thousand engines and thousands of units of materials used in airplane construction.

When an aviation purchasing agent goes to market to buy anything in large lots he can command new respect from his sources of supply. An entirely new schedule of prices is likely to be opened to him. It may cost him the friendship of the local hardware store proprietor and it may cost him a few nights and weekends of hard labor. But it is sure to reduce production costs.

It behooves every man concerned with the purchase of materials in any aviation manufacturing company to work some holiday or weekend going through his stock lists to see where he can save money for his company by purchase of materials in larger quantities.

Flying Equipment

What's new in aircraft, engines and major accessories

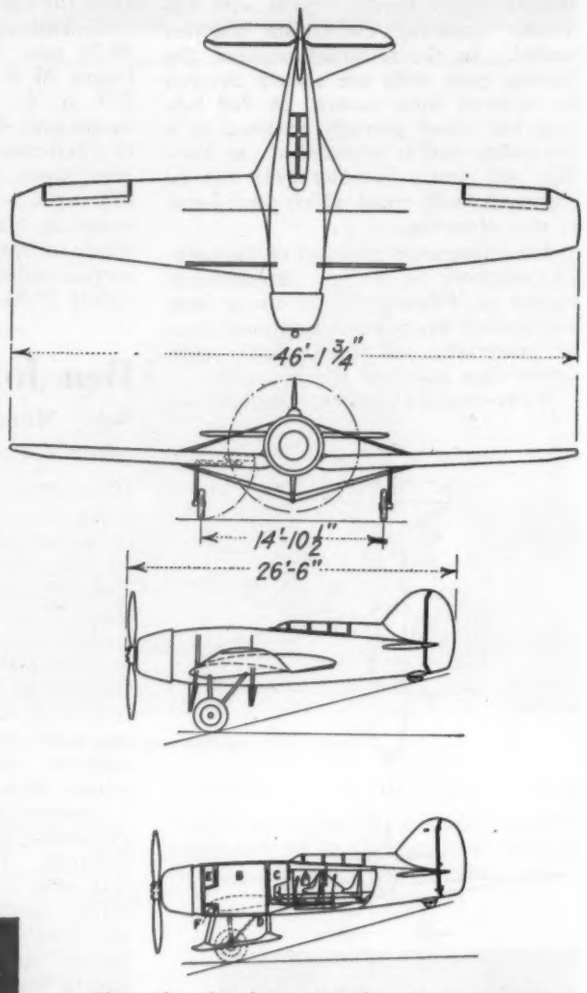
Bellanca 28-70 "Flash"

New version of Mollison's transatlantic plane to have cantilever wing

THE recent record flight of Captain James A. Mollison and the forthcoming New York-Paris race, focus our attention again on the Bellanca Model 28-70 "Flash." A number of refinements have been made in the design and others are planned for ships that may be used in the prospective transatlantic race. During the past summer wind tunnel and static tests have indicated that it will be possible to substitute a full cantilever wing for the braced type in the present version. With this change and with a Twin Wasp engine, a top speed in excess of 300 m.p.h. and a range of over 5,500 miles are expected.

The Mollison Flash which crossed the Atlantic at a speed of 227 m.p.h., is powered with a twin row Pratt & Whitney Wasp Jr. engine rated at 700 hp., carries 600 gal. of gasoline, and is capable of a non-stop range of about 4,000 miles at a cruising speed of 240 m.p.h. Wing construction of the Flash is of wood in the conventional two-spar type with closely spaced ribs, plywood leading edge, and fabric covering. Plywood is also used to cover the top of the landing gear retraction wells. Bracing is accomplished by a system of tie rods from the wing spars to fuselage on top and to two specially designed steel supporting struts connected by a sort of skid below the fuselage.

Fuselage structure is welded chrome molybdenum steel tubing with fabric covering. Stabilizer and fin are of wood construction with plywood covering and elevator and rudders are made of welded steel tubing also covered with fabric. Tab controls on the elevators eliminate the stabilizer adjustment.



Three view drawing and equipment arrangement on Mollison's ship. (A)—oil radiator scoop. (B)—Main fuel tank (480 gal.). (C)—auxiliary fuel tank (120 gal.). (D)—Dump valve. (E)—oil tank (34 gal.) (F)—auxiliary oil tank (10 gal.).

Dallin Aerial Surveys

Flight picture of the "Flash" showing the bracing skid

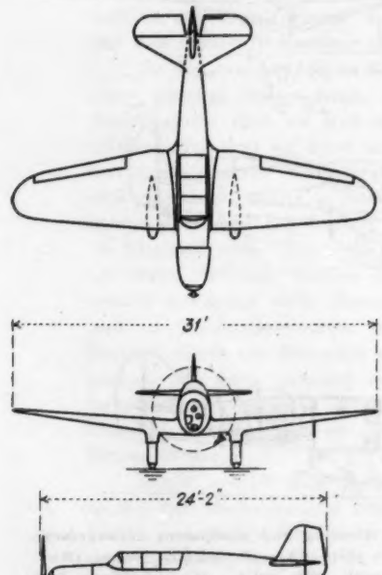
Side view showing smooth contour and neatly faired cockpit enclosure

A conventional hydraulic mechanism retracts the landing gear and the locking arrangement is a mechanism separate and distinct from the retracting devices operated by Arens cable control, from the cockpit. Landing loads are distributed over a triangular truss arrangement. One leg of each triangle incorporates a splined oleo shock absorbing strut. Wheels are of the standard Bendix airplane type fitted with 32x6 smooth tires. Bendix brakes with hydraulic actuating mechanism are installed. In the retracted position, the landing gear wells are closely covered by taylored dural covers. A full balloon tail wheel partially enclosed in a streamline cuff is provided at the fuselage tail post. Landing gear has an extremely wide tread which contributes to ease of taxiing.

The transparent material of the cockpit windows is a new development known as "Pflexiglas." It can be bent and worked like other conventional plastic materials, yet passes light more freely than standard window glass.

A two-bladed Hamilton Standard controllable pitch propeller 10 ft. 6 in. diameter is fitted to the twin row Wasp Junior engine. The ring cowling is of the most recent NACA type and comprises a sturdily built nose ring with four readily removable skirt segments attached by DZUS fasteners. Special one-shot lubricating for the rocker boxes using oil pressure from the engine is installed and an oil radiator with an adjustable scoop opening controlable from the cockpit is provided.

General specifications of the Model 28-70 are: wing span, 46 ft. 2 in.; length 26 ft.; height 7 ft.; wing area, 279 sq. ft.; weight empty, 4074 lb.; useful load, 4276 lb.; gross weight, 8350 lb. Performance figures indicate a maximum speed (at 9,000 ft.) in excess of 275 m.p.h.; cruising speed, 240 m.p.h.; range at cruising, 4,000 mi.; rate of climb to 9,000 ft., 1,500 ft. per min.; service ceiling 26,000 ft.; and absolute ceiling 27,000 ft.



Ben Jones S 125

New Menasco powered monoplane for the private pilot

MODERN in appearance but designed to fit the means of the average private pilot is the Model S-125 by Ben Jones Incorporated, of Schenectady County Airport. This newcomer in the private airplane field is a two place, low wing monoplane of conventional construction, powered with either the Menasco C4 (125 hp.) or C4S (150 hp.) engine. It is well suited to student instruction and other fixed base activities and has sufficient range for extensive cross country flying.

Construction is of the wood, plywood and welded steel tube variety with fabric covering. The plywood covered, two spar wing is covered with balloon cloth before finishing. Wing and tail surfaces are of the cantilever type. The cockpit canopy is built in three telescoping sections, rigidly reinforced. The metal covering at the front of the fuselage is removable to give access to the structure and accessories for inspection and servicing.

Baggage space is provided behind the pilot's cockpit, and is reached through an inside door. Additional pockets under the arm rests add space for miscellaneous equipment items.

All flying instruments are on the rear dash board, but space is left for a duplicate set in the front cockpit. Ample leg room is available in both cockpits and the seat cushions are so designed that they support that part of the leg below the knee. A leather interior finish is standard equipment.

Combination rudder and brake control pedals are used and either brake may be operated individually, with or without simultaneous operation of the rudder pedals. Ball bearings are used throughout the control system. Rudder and elevators are cable controlled while the differential aileron control consists of a system of cables, bell cranks, and push-pull rods. The trimming tab on the left elevator is operated by a heavy gage wire passing through the elevator hinge center line.

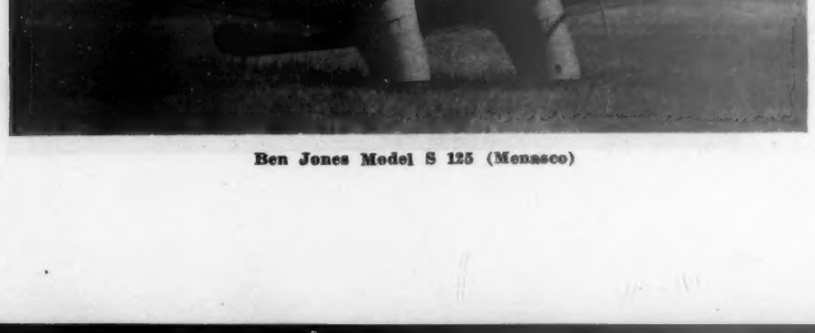
The landing gear is of the cantilever type with streamlined wheel fairings. Wheel suspension is on a fork connected to the shock strut which is attached to a tripod connected to the front spar and to a tubular truss between the spars. A sliding tube connecting the fork and tripod transmits unsymmetrical wheel loads through the tripod to the structure. Landing gear tread is 7 ft. 3 in. The 8-in. tail wheel has a 360 deg. swivel, a steel coil shock spring, and a pneumatic dampener for rebound.

Two fuel tanks of 23 gallons capacity each are placed in the wing on either side of the fuselage, and are removable through the bottom of the wing. The engine is rubber mounted, the fire wall is soundproofed, and the venturi type cowling is attached so as to be free of the main body. These three features contribute largely to the unusual degree of quiet within the cockpit inclosure.

Specifications are span 31 ft.; length, 24 ft.; height, 7 ft. 3 in.; wing area, 140.5 sq.ft.; weight empty, 1,125 lb.; gross weight, 2,000 lb.

Performance is as follows:

	Menasco C4	Menasco C4S
High speed	151 m.p.h.	162 m.p.h.
Cruising speed	136 m.p.h.	146 m.p.h.
Landing speed	45 m.p.h.	46 m.p.h.
Take-off run	130 yd.	120 yd.
Rate of climb	1,020 ft. per min.	1,410 ft per min.
Cruising range	730 miles	680 miles.
Service ceiling	14,100 ft.	18,200 ft.



Ben Jones Model S 125 (Menasco)

XOZ-1 Gyroplane

Rotary wing craft for Navy tested in Philadelphia

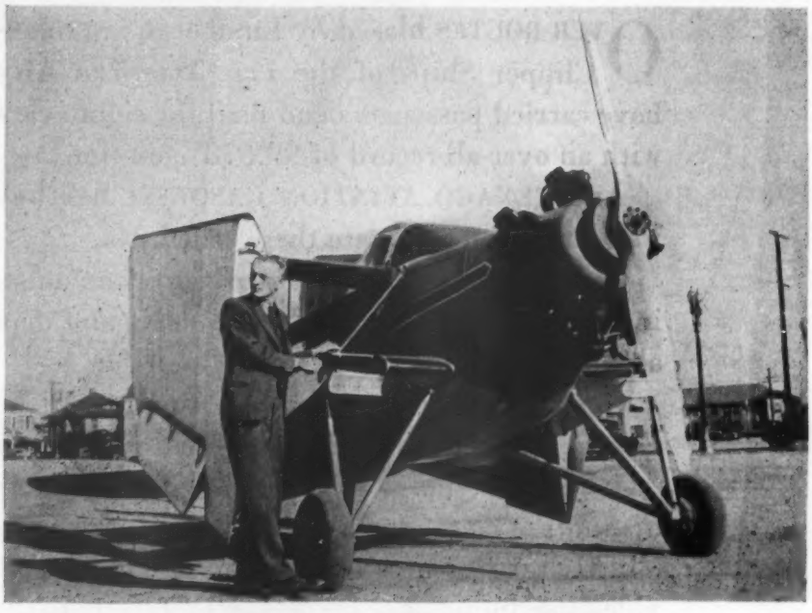
ANNOUNCEMENT has just been made by E. Burke Wilford, president, Pennsylvania Aircraft Syndicate, of the first flight of the pontoon-mounted gyroplane XOZ-1 built for the Navy Department. The flights were made at Frank Mills' Seaplane Base at Essington, Penna., by Pilot Albert Sidlow under the direction

of Paul Hovgard, flight consultant. Witnesses included Elliott Daland, chief engineer and Mr. Wilford. The XOZ-1 can be considered a compromise between the airplane and the autogiro since it has a fixed wing which carries from 60 to 80 per cent of the load in cruising. Although the ship weighs less than 2000 lb. gross, it has 900 sq. ft. of lifting surface. The rotor is of the feathering type which has been developed exclusively in this country by Mr. Wilford's organization.

General specifications of the XOZ-1 are: rotor diameter 32 ft.; fixed wing span, 28 ft.; rotor disk area, 800 sq. ft.; fixed wing area, 100 sq. ft.; engine horsepower (Kinner R-5) 155; gross weight 2000 lb.

It is the purpose of the company to develop the XOZ-1 into an aircraft which will have a minimum flying speed of less than 40 m.p.h. and a top speed of between 150 and 200 m.p.h. with a reasonable horsepower loading.

The XOZ-1 Gyroplane recently tested by Pennsylvania Aircraft Syndicate



W. B. Kinner's new folding wing coupe

W. B. Kinner Coupe

New model resembles folding wing predecessors

A NEW folding wing, enclosed, two place plane has been built and test flown recently by W. B. Kinner, Southern California designer and manufacturer of Security-National airplanes for the last several years. The characteristic folding wings of the new model can be placed in their folded position by one man in about three minutes. Seaplane floats can be substituted for the land undercarriage equipment.

The wing span of the new ship is 40 ft. and the overall length, 24 ft. Maximum speed, with a 125 hp. engine, is about 120 m.p.h. and ceiling about 10,000 ft.

Wright 3-Way Drive

Constant Speed Governor Now Adapted to Whirlwind

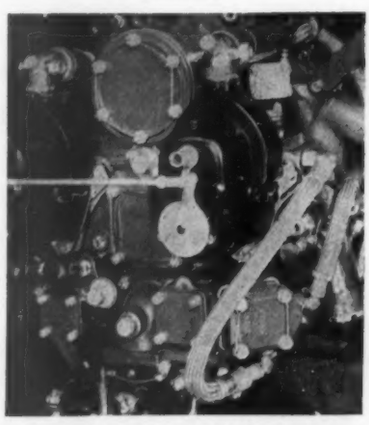
THE numerous advantages in the use of the constant speed propeller are already well known, and automatic pitch variation has been an important contribution to all types of airplane operation. In order to apply the Hamilton Standard constant speed governor to the Whirlwind engine, the Wright Aeronautical Corporation has designed a new accessory drive which can be used on all 7 and 9 cylinder Whirlwinds regularly equipped with the two-position hydro-control mechanism. The constant speed propeller was heretofore available only on the highest powered Cyclone in the Wright line.

Attached below the right magneto at the fuel pump drive location, the new accessory drive is a three-outlet box using beveled gears to provide drives for the constant speed propeller governor, a fuel pump, and a vacuum pump. If all of these accessories are not desired, the gears for either the fuel pump or the constant speed governor or both may be omitted. The usual mounting studs are used for installation on 7-cylinder Whirlwinds already in service and the 9-cylinder Whirlwinds will require the addition of one stud for which provision has been made.

In other ways the installations are similar. The governor is mounted on the drive by means of an adapter shown in the accompanying illustration. Two oil lines are fitted to this adapter, one from the engine oil supplied to the adapter, the other from the adapter to the main section, where it enters a special fitting which replaces the hydro control lever.

Oil lines for the 7-cylinder Whirlwinds are both of the flexible Breeze type; on 9-cylinder Whirlwinds however, because of the smaller space between the cylinders, a small diameter rigid steel oil line is used from the governor pump to the nose section.

(*Turn to page* 38)



Propeller governor installation on a Whirlwind 350. The right-hand outlet of the three-way drive (below the right-hand magneto) takes a Hamilton-Standard governor pump and regulator, the lefthand outlet a vacuum pump, and the lower outlet a fuel pump.

THREE PASSENGER MILES

OVER ROUTES blazed by Lindbergh . . . the flying Clipper Ships of the Pan American Airways have carried passengers and mail for eight years . . . with an over-all record of 99.678% on time.

And TEXACO AVIATION GASOLINE has helped Pan American maintain these schedules.

Surely a record to be proud of. Surely an outstanding testimonial to the uniform quality and dependability of Texaco Products.

One of the reasons why Pan American, T.W.A., Delta, Hanford and other airlines choose Texaco Aviation Gasoline is its exceptionally well balanced *distillation characteristics.*

This quality of Texaco Aviation Gasoline provides maximum power, *and definitely reduces the possibility of carburetor icing.*

Whether it be on the charted routes of the transports or among the clouds with the test pilots, there is a Texaco Aviation Gasoline of the correct octane rating for your equipment.

Texaco Airplane Oils are made by special refining processes to obtain their extreme purity. They are free from harmful gum and carbon forming elements. Many leading airlines use them exclusively.

A Texaco aviation representative will be glad to provide practical engineering service to prove the economies of Texaco Aviation Products.

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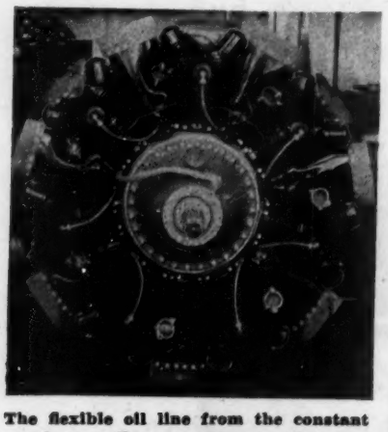
Products

(*Continued from page 35*)

Oil is taken from the engine to the governor pump from which it is delivered to the propeller mechanism under approximately 200 lb. pressure. There it turns the blades into low pitch. The flow of the oil, however, is controlled by another unit of the governor, a centrifugally operated valve. This valve directs the oil to the propeller mechanism only when the engine is slowed down below the r.p.m. for which the governor is set. The propeller then goes into low pitch and the engine returns to its proper speed. The valve remains closed as long as the engine speed is correct. If the speed increases the valve moves in the other direction allowing oil to return from the propeller, permitting the weights on the propeller blades to turn them into higher pitch which slows the engine to proper speed.



The flexible oil line from the constant speed propeller governor to the nose section will fit comfortably beneath a nose exhaust collector ring. On 9-cylinder Whirlwind, a small diameter rigid steel oil line is used.

G-100 Cyclone

TWA cooperates on new design. Wright's soundproofed test cells

JACK FRYE, TWA president, has long felt that what the airlines needed was an engine designed specifically for airline work. So TWA and Wright Aeronautical Corp. engineers set out to design the first "heavy duty commercial engine," to use Frye's words. Last month we journeyed to the Wright plant at Paterson, N. J., for a demonstration of the finished product—a new Cyclone in the G series, known as G-100.

TWA has announced an order for 41 of them for installation in the fleet of eight modified Douglas DC-3's now building at Santa Monica. These ships are scheduled for delivery beginning in January, and will increase TWA's fleet of Douglases to 50, flying over 1,000,000 miles a month.

The new G-100's develop 1,220 hp. at 2,400 r.p.m. at sea level for take-off (with 100 octane fuel). They are rated at 1,100 hp. for take-off, however. Output at altitude is 950 hp. at 5,200 ft.

In line with regular practice of operating below full throttle, TWA will take only 1,000 hp. from these engines at take off, and will cruise at 550 hp. (45 per cent of maximum power available). This will permit present schedules to be maintained, and at the same time leave a substantial reserve of power. Because of this large reserve of power and advances in design of the engine, TWA expects to lengthen periods between overhaul from the present 400 hours to close to 500 hours.

The G-100, a single row, nine-cylinder radial, is a development of the 1,000 hp. G, of which 1,500 were sold in the first nine months of this year. Most radical design change is a switch from aluminum alloy to steel for the crankcase—the first of its kind to be used on a production radial engine in this country. The steel crankcase allows a substantially thinner section, and for its 50 per cent increase in strength, adds but 30 lb. to the engine's total weight. The extra power available in the G-100 (as compared with the G) weighs only .5 lb./hp. To better cool the cylinder head and increase life of cylinder walls, $\frac{1}{16}$ of an inch has been added to the height of the heads. This allows a longer piston, with enlarged bearing surface on the piston skirt.

To overcome the icing problem, the new Cyclones are fitted with the recently-developed Chandler-Groves carburetors (see AVIATION for May, 1936). With this carburetor and some refinements in the valve timing, fuel consumption is held to .43 lb./hp. hr.

Rocker arm lubrication is automatic, oil from the engine supply feeding the bearings and draining back to the crankcase through tubes within the push-rod housing.

The main connecting rod has been redesigned and strengthened to take the greater stresses imposed by the boost in power. Cylinder walls are nitrided for extra hardness.

The third development we were privileged to observe at Paterson was the Engineering Department's new test cells. These structures, constructed at a cost of $100,000, permit 24-hour a day test operation. Before their construction all of Paterson used to complain of the noise of Wright's testing operations, but the impressively effective soundproofing in the new stands have eliminated that. In the control room between the two engine cells, we were easily able to converse normally, even when the great engine was turning over at 2,400 r.p.m. and kicking out 1,220 hp. Yet when the door into the corridor below was opened, the top of our head nearly came off with the racket.

The efficiency of the soundproofing results from three things: In the first place, the walls of the cells are made of a porous substance which absorbs much of the sound. Secondly, the vent into the open air—straight up—consists of a deep honeycomb which breaks up the sound waves as they form. And lastly, the suspension of the engine itself is a contributing factor. It is mounted on the end of a large steel cylinder, about 10 ft. long, which is suspended 10 ft. above the floor in a three-point cradle of cable loops anchored to the walls and floor. Vibration is absorbed at the anchorage points by rubber washers which separate the bearing surfaces from the building structure. Walls and ceiling in the propeller plane are heavily reinforced with steel.

Engine controls are operated by a

Wide World

The G-100 on the test stand. Note the web of supporting cables. The control column extends across the upper right.

mechanical linkage through an arm attached to the side of the cell. Controls and gages are set up in the observation room between the two cells, where are also located oil coolers and fuel supply.

RCA Crystal Unit

Attachment furnishes crystal control of receiver frequency

A NEW ATTACHMENT to provide crystal control of receiver frequency in airline or airport traffic control work has been brought out by R.C.A. (Camden, N. J.) The Model AVA-8 Crystal Attachment is made in several forms, as a cabinet to add to existing receiving equipment or as a rack panel unit to match existing panel equipment.

The AVA-8 provides crystal control of any two frequencies in the aviation communications band of 2000 kc.—6500 kc. The receiver may be pre-tuned to one frequency, thus providing for three-frequency operation with two frequencies being crystal controlled. The receiver may also be used as a conventional receiving unit.

Crystals are of the "V" cut low temperature coefficient type mounted in R.C.A. Model AVA-10 crystal holders. Two crystals, ground for the desired frequencies are supplied and others may be obtained if desired.

The AVA-8 unit consists of a duo-radio frequency amplifier; duo first detector with crystal oscillator combined; and a common intermediate frequency amplifier. The unit receives its plate voltage supply from the receiver chassis but the tube heaters are energized by a built-in transformer. The additional 110-volt a.c. power required is 12 watts. Special interconnecting cables are supplied for wiring the unit to the receiver. In use the Model AVA-8 attachment replaces the radio frequency and first detector and oscillator and adds another stage of intermediate frequency amplification to the receiver. The unit is carefully shielded.

Dimensions and weight are: (two tone gray cabinet mounting) width, $13\frac{9}{16}$ in.; depth, $8\frac{1}{2}$ in.; height overall, 9 in.; weight, $15\frac{1}{2}$ lb. (rack panel mounting, gray or black crinkle finish) width, 19 in.; depth, $7\frac{5}{16}$ in.; height, $8\frac{3}{4}$ in.; weight, $18\frac{1}{2}$ lb.

Rack panel mounting (AVR-8)

Hirth Engine

German builder announces completion of 1000th engine

TO PRODUCE 1,000 aircraft engines of any type is an outstanding accomplishment. It is still more remarkable when the engine in question is one used mainly for sportplanes. Such an engine is being built in Germany. It is the HM6OR Model, manufactured by the Hirth-Motoren G.m.b.H., Stuttgart-Zuffenhausen.

Designer of this 80 hp., four cylinder in line, inverted, aircooled engine is Hellmuth Hirth who passed a number of years in this country as an assistant in the private laboratories of the late Thomas A. Edison, and has been engaged in piloting and aircraft engineering for thirty years. He is a brother of Soaring Pilot Wolf Hirth.

The HM6OR engine has powered many race winning and record breaking airplanes built in Germany. Many of the light planes, including Klemm, Fieseler, and Bücker use it as regular equipment.

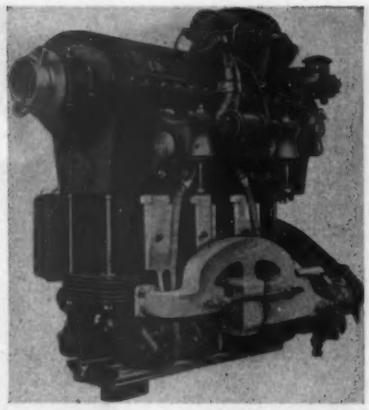
Cabinet mounting (AVA-8) over AVR-5A Airport Receiver

Sensitive Altimeter

Pioneer instrument has direct reading barometric setting

AN altimeter considerably more sensitive than the standard instrument and embodying a direct reading barometric setting has been introduced by the Pioneer Instrument Company (New York). Instead of the conventional single pointer, two and sometimes three concentric pointers are used to indicate altitude in tens, hundreds, and thousands of units. The barometric setting device, in the form of a Veeder counter, is built into the lower portion of the dial distinctly separate from the altitude scale. The setting shows directly the exact adjustment of the altimeter to existing atmospheric pressure conditions, facilitating setting and insuring direct readings at a glance. Large numerals provide a distinct index that does not require reference lines for setting and which may easily be read from any angle without paralax error.

For military ships requiring a barometric pressure setting in equivalent feet of altitude there is a further advantage. The counter setting is in feet of altitude above or below standard atmosphere at sea level. Above this point the numerals are white figures against a black background; below the white figures appear against a red background. The barometric pressure adjustment is made by a knob on the lower front part of the instrument. A feature of the sensitive altimeter is complete built-in temperature compensation. The instrument remains accurate and unusually free from lag.



The Hirth HM6OR engine

Pioneer Sensitive Altimeter

● Metals, as well as men, suffer from fatigue—from loss of strength due to repeated or alternating stress. But metals that are susceptible to this weakness have no place in aircraft engines.

Here are needed special metals, selected for their proven ability to resist fatigue, stress and wear.

To-day the Nickel Alloy Steels are used for numerous parts of these heavily burdened power plants because their superior mechanical properties minimize the danger of breakage and wear.

Through a partnership with Nickel the simple steels are made unusually tough and strong, hence more enduring and reliable. Consultation on problems involving use of alloys containing Nickel is invited.

NICKEL ALLOY STEELS

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

Buyers' Log Book

What's New in Accessories, Materials, Supplies, and Equipment

Hydro Degreaser

Cold Cleaning tank uses Gunk as a solvent

CONSTRUCTION PLANS for a cold immersion cleaning tank known as the "Hydro-degreaser" are offered without cost by the Curran Corporation (Malden, Mass.), manufacturers of "Gunk" solvent compound. This device has been developed to remove heavy accumulations of oil and grease from airplane engines and parts and has found application in many other industries.

The Hydro Degreaser is constructed in two compartments, one for soaking and the other for rinsing. In extreme cases, air line agitation may be used to create turbulence of the solvent bath. This reduces the time necessary for emulsion to only a minute or two. The rinsing section is directly connected to the sewer drain and carries off the dissolved oils and greases in a safe emulsion form, the tank being self cleaning and the process continuous.

The device eliminates the cost of steam or gas heat and the solution does not irritate the skin and requires no protection for the operator's hands. It is rated as a safety solvent by the Underwriters Laboratories. Additions are only necessary to cover "dragout" loss. —AVIATION, December, 1936.

Jack-of-All-Trades

American Chain Company offers stretching jack with non-slip cog

FOR operations involving stretching, pulling, binding or lifting, the Welded Chain Division of the American Chain Company, Inc. (Bridgeport, Conn.) has developed a simple utility jack. The 34 lb. tool handles working loads to 4,000 lb.

When in use the stretcher chain fits over teeth in a sprocket wheel mounted in a frame. Raising and lowering a handle attached to an eccentric axle transmits power to the wheel through two pawls.—AVIATION, December, 1936.

Vari-Speed Control

For portable electrical tools and other small motors

A SPEED control for portable electric tools and other small universal type motors has been placed on the market by the Pennsylvania Aircraft Syndicate (Philadelphia). The Russell-Wilford "Vari-Speed" is light in weight and only 1½ in. x 3 in. x 1 in. in size. It can be mounted on almost any electric tool up to 220 volts and under 600 watts input. To obtain 1,000 hours life of contact points it should not take over a maximum of 100 amperes at ½ normal speed. There is a condenser across the contacts to increase the life of the device. Wiring is completely enclosed.

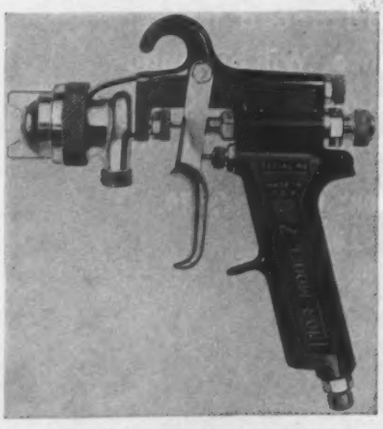
The Vari-Speed is operated by turning a thumb screw on the case, giving a range from 1-½ rated speed. There are no running parts to wear and air from the cooling fan furnishes the governing medium.—AVIATION, December, 1936.

Thor Spray Gun

Model 7 has 20 different nozzle set ups

A NEW SPRAY GUN capable of spraying materials ranging from airplane dopes, lacquers, and enamels up to sound deadener and cut-back asphalt has been introduced by the Binks Manufacturing Company (Chicago, Ill.). The Thor Model 7 can be provided with approximately twenty different nozzle set ups which are interchangeable. Among the improvements claimed by the manufacturers are greater speed, less air consumption, and more perfect atomization.

Unique among spray guns is the method of introducing color into the gun body which is embodied in the design. The body is of drop forged aluminum with a black electrolytic coating for surface protection.—AVIATION, December, 1936.



The Thor Model 7 by Binks.

Russell-Wilford Vari-Speed.

Tubing Data Book

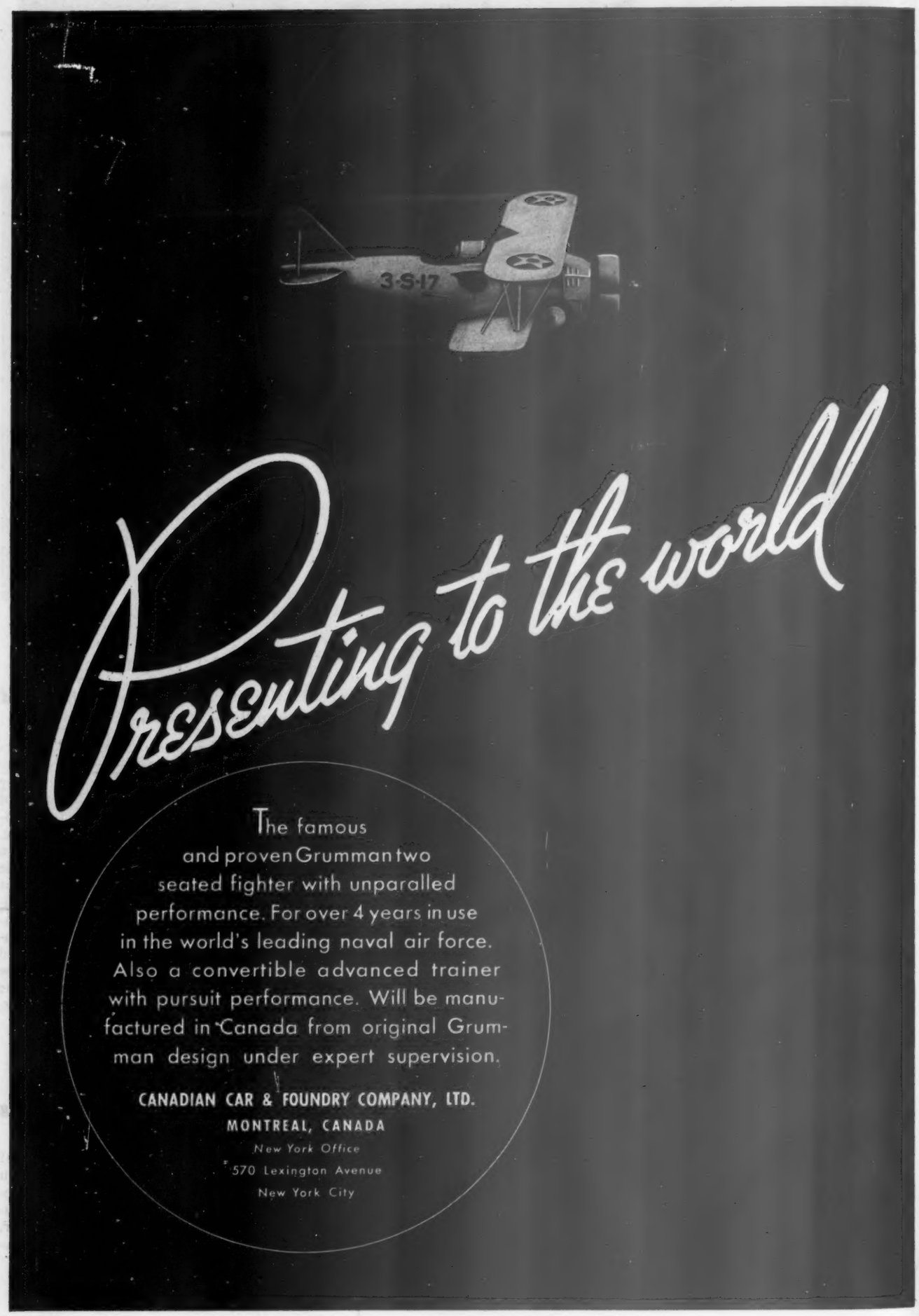
Summerill publishes loose leaf handbook for engineers

AN attractively bound handbook of aircraft tubing has just been published by the Summerill Tubing Company (Bridgeport, Pa.). In the 39 pages of tables, charts, and formulae are tabulated the properties of round, streamline, square, and elliptical sections. Column strength curves for round, streamline and square sections are included for yield points higher than commonly employed at present in anticipation of increases in allowables. Other data valuable to designers are also incorporated in the loose-leaf pages which may be replaced or increased in number as the occasion arises.—AVIATION, December, 1936.

Dalco Landing Light

Hydraulic Retractable landing light introduced on Coast

IN the announcement and description of the Dalco retractable landing light in the November issue of AVIATION, a typographical error was made in the spelling of the name of the manufacturer. The above spelling is correct—AVIATION, December, 1936.


3-S-17
Presenting to the world
The famous and proven Grumman two seated fighter with unparalled performance. For over 4 years in use in the world's leading naval air force. Also a convertible advanced trainer with pursuit performance. Will be manufactured in Canada from original Grumman design under expert supervision.
CANADIAN CAR & FOUNDRY COMPANY, LTD.
MONTREAL, CANADA
New York Office
570 Lexington Avenue
New York City

Operators' Corner

An exchange of ideas on the problems of the commercial aviation industry

QUESTION 18: What is to be done about the problem of the young student who has learned to fly with an established operator and wants to go into business for himself? Should the parent school encourage him by assistance of various kinds, or should it treat him as a possible competitor? Is it good business in the long run to try to sell him a ship, find an airport for him and instruct him in operating methods, or should the older school confine its activities to instruction alone?

Encourage new operators

IT is our belief that a flying school, or an airplane distributor who operates a school in conjunction with his activities, will do well by assisting his student graduates in finding a place in the industry. The student who has acquired a transport pilots' license, and is the type who can assume responsibility and possesses some knowledge of business principles, should be encouraged and assisted in establishing a small school or a small operation in the smaller communities that have not as yet been offered flying service. There are undoubtedly many towns with populations up to 10,000 that do not have a flying service and that would afford one pilot with a small plane, such as an Aeronca. enough business in student training and taxi work to support himself for some time with the possibility of a sale occasionally to prospects of his own and the sale of accessories to his students. For plane distributors this offers an outlet for more sales, first to the young operator getting started, and then to prospects acquired through this new dealer. Sales during the past summer in small communities have definitely shown that this is possible and it is an opportunity that the distributors and schools should not overlook.—A. ELLIOTT MERRILL, *President, Washington Aircraft & Transport Corporation, Boeing Field, Seattle, Wash.*

Need more honest competition

WE believe that there is an undeveloped opportunity in the operation of fields near small towns and that any increase in the number of such fields will benefit charter business and stimulate airplane sales to private fliers by increasing the usefulness of the airplane.

We believe that aviation needs honest competition. We mean that there are too many pilots operating commercially just as a side-line and not enough who are really making a business of aviation. The more of us there are who are selling the public on flying, the quicker the public will be sold, and the more business there will be for all of us.—A. H. KNOUFF, *Business Manager, Swiftair Service, Rowland Field, Athens, Ohio.*

QUESTION 19: What method do you employ to insure completion of charter service within the time agreed upon between yourself and your prospect? How do you compute the necessary leeway between the promised arrival time and the cruising speed of the airplane? Do you hold standby equipment ready to overtake your ships if they are forced down by mechanical trouble?

Allow some latitude

IT is seldom that we are asked to indicate specifically what time we are to arrive at a charter trip destination. Obviously we are asked "about how long will it take," and in giving the answer we usually allow enough latitude so that we are not embarrassed—rather, we usually exceed our intimated schedule, and thereby please our passenger in so doing.

In estimating our time, we of course know the distance, our own cruising distance, and the approximate number of stops necessary. We allow at least 30 minutes per stop regardless, (and then try to do it as fast as humanly possible) and after we have computed all that we usually add a little time for possible emergency and, as stated above, so that we will please our customer. We do not hold standby equipment ready to overtake any ship forced down for any reason.—KARL E. VOELTER, *Karl E. Voelter, Inc., All American Airport, Miami, Fla.*

Standby ships impracticable

IN connection with the limited amount of charter work we do, we find that the customer usually appreciates that there is always a chance of delay because of weather or mechanical trouble, and it is therefore unnecessary to guarantee any definite time of arrival. Except in the case of a large operator having several ships available for charter work, it would seem to us very impracticable to hold an extra ship and pilot in readiness to overtake another ship in the event of mechanical trouble.—GEORGE A. VIEHMANN, *Manager, Standard Flying Service, Inc., Somerset Hills Airport, Basking Ridge, N. J.*

Estimates based on experience

WE do not guarantee any time limit. We estimate time to points where we have not made flights at about 5 per cent below cruising speed. We keep time records on all cross-country flights to use as a basis for future estimates.

In about 2,000 hours of all kinds of flying we have had only two forced landings, neither of which caused any serious delay; so we feel that "standby" equipment would be just unnecessary overhead for us.

Where connections are made with airlines, we allow about 45 minutes over our estimated flying time.—A. H. KNOUFF, *Business Manager, Swiftair Service, Rowland Field, Athens, Ohio.*

Question 20

(Answers to be published in January)

DO YOU believe that a special license should be required for flying instructors? If so, what qualifications should be required? Should the number of hours needed be the same as that for the transport license or greater? Should some estimate of ability to impart knowledge be included in the requirements?

Pacific Progress

(Continued from page 17)

force has been built up so that work can proceed by shifts on the Clippers through twenty-four hours a day if necessary.

Training crews

If the Pacific Division had been otherwise a finished thing ten months ago, the task of crew training would in itself have presented a major problem. Men had long been in training in the Caribbean Division for full trans-oceanic operations as described in AVIATION for August, 1934, but no conceivable term of such practice and training could substitute for actual experience in the Pacific. The survey flights of the Pan American Clipper and the preliminary flights along the California coast had given a beginning of this experience to two crews of six men each. During the months that

(Turn to page 44)

(*Continued from page 43*)

followed few departures took place from Alameda with less than eight or nine crew members. Endlessly these men practiced their navigation under the tutelage of Frederick Noonan and George Canaday. For long hours they flew their ships with curtained cockpits over mid-ocean or in practicing approach by instrument and radio to the terminal at Alameda. Through each flight they adhered strictly to the pre-arranged plan of watch changes and relief that give each man some 20 per cent of his time off duty. As a result there are at present five full crews in Pacific service and the nucleus is already under way for two additional ones. The results these men have achieved is an excellent tribute to the faith placed almost six years ago in the concept of a six-man multiple crew, each one of which (save the flight engineer and the radio operator who were super-specialists) could fly the ship, take complete charge of navigation, relieve the engineer and radio officers, and deal with all problems of international law and negotiations connected with such an operation. Not only have these men proven up to their tasks but studies of fatigue carried out by a flight surgeon before and after each Alameda departure, have shown that so far they have acclimated themselves very well to the work.

Back to the bubble

Systems of navigation and radio had also a year ago still to prove themselves. The whole concept of a trans-Pacific airline was based on the assumption that perfection could be obtained in both of these departments.

The navigation as carried out is a four-guarded process. Basic are celestial observations taken day and night at least at hourly intervals. Of possible interest is the fact that the flight personnel have had opportunity to try out various new instruments, various new methods of navigation, but all fall back on a very good bubble sextant and only one or two of the refined methods such as Dreisinstok and Ageton. After studying all various short cuts for aerial navigation they have come to feel that the application of the old principles in a common sense way are still applicable to aerial navigation.

Secondly the ship's position is carefully figured by dead reckoning throughout each flight, aluminum powder drift bombs or magnesium flares being dropped regularly to check on the effect of wind on the ship's motion whenever the surface of the ocean is not obscured by clouds. A third guard and one which from the results shown, would be completely reliable in its own right is the use of direction finding radio from each base on the route. This equipment has proven quite accurate even when the Clippers are midway between Alameda and Honolulu and becomes weirdly precise as the ships near each terminal. In addition each Clipper has its own radio direction finder with which it can take bearings on bases or steamers and even on broadcasting stations.

To say that no Clipper in all of the half-million miles of flying has ever been more than a few miles from its computed course would not be to put it too strongly. Again and again they have passed directly over ships in mid-ocean they have set out to intercept. On several occasions they have found their way onto San Francisco Bay through that region's proverbial fogginess. Recently one of the Clippers returning from Honolulu carried an executive of the Matson line as passenger and as a demonstration, worked out a course to pass directly over a Matson liner, yet 10,000 feet above it and with a complete cloud layer obscuring it from view. Arrived over the ship's computed position, the Clipper dropped a magnesium flare. Immediately the liner radioed them that the flare had dropped somewhere within a few miles of it.

For upper air weather forecasts over the Pacific, of course, there was no precedent whatever. From Manila, Guam, Honolulu and San Francisco there were data available from weather bureau stations that included periodic pilot balloon observations. But from the great areas in between, ship reports that were available were only partially usable for airline work. The system's own bases at Midway and Wake filled great gaps of course and bases at the other islands began immediately to supplement the weather bureau observations. A system was worked out for coordinating data from surface stations on the Asiatic continent, from Japan and other Pacific Islands and of course from stations in North America. This spring a further great resource was added when an arrangement was made for upper air balloon soundings from all Matson liners plying between California and Honolulu, each liner being equipped with complete theodolite and balloon equipment and its officers being indoctrinated in sounding procedure.

From the outset the analyses carried out by the system's meteorologists of the Pacific weather map have been based on the polar front theory and it has yielded persistently high accuracy.

As a result probably for the first time heavier than air craft have been flying an ocean not on a Great Circle chart but on the weather map. Repeatedly in recent months Clippers on the long flight between Alameda and Honolulu have deviated as much as 300 miles from the Great Circle course in order to avoid unfavorable winds or to secure favorable ones. Another measure of the combined accuracy of navigation and weather forecasting is the effectiveness of the flight forecast system made before each departure. With the latest weather analysis at hand, weather, operations and flying personnel prepare an estimate of the time the proposed flight will take. Even on the California-Hawaii hop which averages eighteen to twenty hours in duration, analysis of recent months have averaged a precision of a few tenths of an hour and have never deviated from the actual realized time by more than sixty minutes.

Coupled with the flight plan, of course, is a complete system of cruising control laid out on a blue print for each stage of the crossing. At the flight forecast conference, operations personnel carefully work out most economic levels of flight for each zone (the California-Hawaii leg being broken into some five flight zones). For each level and for each zone the flight personnel have on their blue print exact schedule of engine R.P.M., throttle settings, etc., to which they adhere very closely. If anything, the accuracy of fuel consumption forecast is even more accurate than the forecast of the flying time. As a result no Clipper in the entire half million miles of flying has ever landed at Alameda or Honolulu with less fuel than that sufficient for five hours of additional flying and fuel loads before each departure are now figured on forecast plus six hours of margin.

The future

The future of the picture seems definitely encouraging. With planes, engines, men, navigation and weather worked into a smoothly coordinated system, there seems little likelihood of a repetition of last winter's troubles. Typhoons are and will always remain a source of potential delay at the Western end of the system but no more so than for any other form of transportation.

With developments of fuel, engines and operating practices it seems assured that passenger allowances between San Francisco and Honolulu can be steadily increased. Mid-ocean bases will be further improved by a third expedition which sailed early in October to complete construction and install additional equipment. The opening of the final link between Manila and the China Coast long-proposed and now in immediate prospect, should do much to increase the whole airways' effectiveness. But somehow one cannot avoid a feeling that, like the wartime rookey out on a hike was told by his hard boiled sergeant "the first half-million miles are the hardest" that trans-oceanic flying boat transport is a realized and proven thing.

News of the Month

Highlighting recent events in the aviation world.

★ ***Domestic Transport*** **. . . Eastern Air buys Wedell-Williams; Pennsylvania and Central consolidate . . . Chicago & Southern and Braniff join the TWA move to lower fares for Winter traffic, while United, American, and Eastern refuse to join the move . . . Northwest celebrates ten years' operation . . . Many lines report increased traffic for nine months and third quarter periods . . . Baltimore selected as Western terminus for PAA's experimental Atlantic flights.**

★ ***Army, Navy, Coast Guard*** **. . . North American, Stearman, get orders for 267 planes for the Air Corps . . . 66 Navy patrol bombers from Consolidated . . . Coast Guard asks for bids.**

★ ***Private Flying*** **. . . Two groups of light planes will cruise to Miami for the annual maneuvers.**

★ ***Industrial*** **. . . British Airways orders four Lockheed Electras for commercial use . . . Brazilian army contracts for 30 Stearman trainers . . . Wage increases granted by all divisions of United Aircraft . . . Northeastern distributorship for Ryan goes to O. J. Whitney.**

★ ***Financial*** **. . . Ten companies report profits.**

Two Interline Shuffles

Eastern Air buys Wedell-Williams, to tap the Mexican market; Pennsylvania and Central consolidate

THE FIRST important airline acquisition since Lehman Bros. bought control of TWA from General Motors in 1935 was announced Oct. 30. Pending approval by the Post Office Department, Eastern Air Lines Division of North American Aviation, Inc., has purchased the equipment and franchises of Wedell-Williams Air Lines, operating a daily service with mail, passengers and express between New Orleans, La., and Houston, Tex.

Eastern, operating Chicago-Miami, New York-Miami, and New York-New Orleans routes, will now be 329 miles nearer Pan American's western terminus at Brownsville, Tex. Already Atlantic seaboard and Chicago traffic are fed into the PAA system at Miami.

Eastern is planning extension of the route from Houston to the Mexican border (presumably to Brownsville), which would give the line connections with both major PAA terminals for traffic to Mexico, Central and South America.

Post Office Solicitor Karl Crowley has indicated that he will recommend Post Office approval of the sale, necessary because it involves transfer of a mail contract. The line will be known as the Wedell-Williams division of Eastern Air Lines, and most of the present operating personnel will be retained.

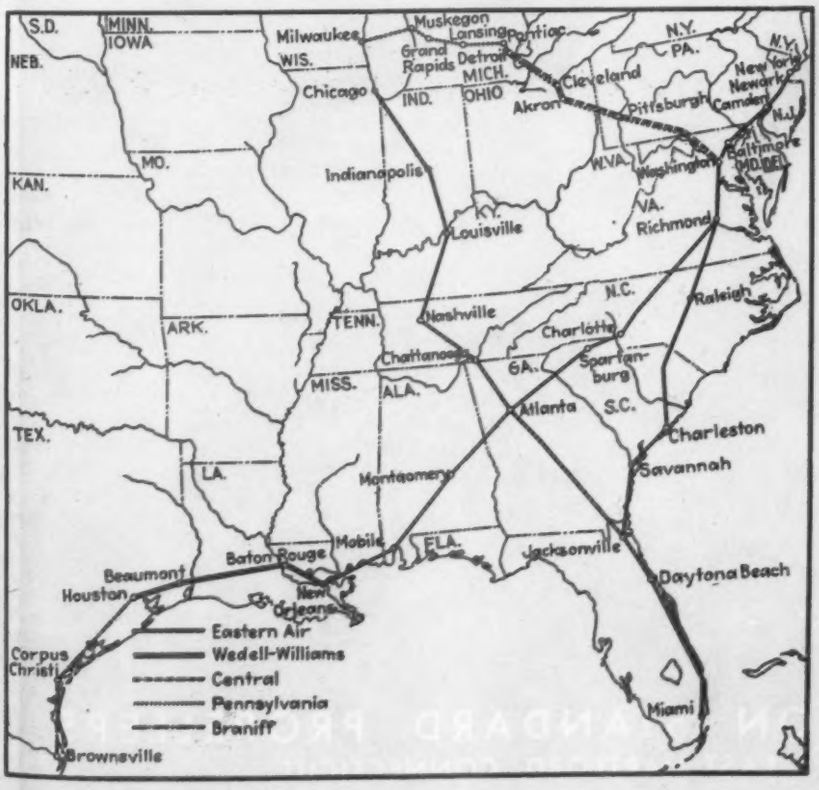
Wedell-Williams was organized in 1930 by the late Harry P. Williams and the late James R. Wedell. First operation was a weekly service between New Orleans and St. Louis, which was soon expanded to daily service. The same year daily service to Shreveport was provided, and later extended to Fort Worth.

When mail contracts for these routes were not forthcoming, the routes were abandoned, and in 1934 Wedell-Williams purchased the mail contract for the New Orleans-Houston route from Robertson Airplane Service Co. Harry Williams' widow, Mrs. Marguerite Clark Williams, was president of the line at the time of the Eastern Air purchase.

Another change in the air mail map culminated Oct. 22 when the Post Office Department approved the merger of two old rivals—Pennsylvania Airlines and Central Airlines. The merger has been rumored for months. The Pennsylvania-Central Airlines Corporation—which will operate the new consolidation—was incorporated in Delaware, for $300,000, last September. But no confirmation came from either company until late in October.

Pennsylvania Airlines history dates back to April, 1927, when Clifford Ball dumped a sack of mail into an open cockpit Waco and took off from Bettis Field, near Pittsburgh, and flew to Cleveland. Two years later the line was extended to Washington, and in 1932 started carrying mail over the Washington - Pittsburgh - Cleveland route. Flying equipment consisted of tri-motored Stinsons seating seven passengers.

By 1933 demands for more space and speed made necessary the purchase of Ford tri-motors. Then in 1934 the



HAMILTON STANDARD
Controllables

ON NEW BASIC TRAINERS

To acquaint army student-pilots with an important feature of high-performance aircraft, the new basic training ships of North American and Seversky are now equipped with Hamilton Standard Controllable Pitch Propellers . . . further evidence of the widespread use of the controllable pitch principle.

HAMILTON STANDARD PROPELLERS
EAST HARTFORD, CONNECTICUT
DIVISION OF UNITED AIRCRAFT CORPORATION

company lost its mail contract in the general cancellation, and, reorganized as Pennsylvania Airlines & Transport Co., extended its operation to Detroit, to be eligible to bid for a new contract.

Pennsylvania was underbid, however, by the newly-formed Central Airlines, which has held the Washington-Detroit contract (Route 11) until the recent consolidation of interests.

Meanwhile Pennsylvania bought the Kohler Aviation Corp., which had pioneered the Detroit-Milwaukee route, across Lake Michigan, in 1929. This enabled the company to make a successful bid for the contract for this route. Passenger and express service on the Washington-Detroit route has continued for the past two years in lively competition with Central.

Officers of the new corporation are drawn almost entirely from Pennsylvania's list: C. Bedell Monro will continue as president; Frederick R. Crawford, vice-president and secretary; W. J. Austin, vice-president in charge of traffic; R. G. Lochiel, treasurer. Only newcomer is J. H. Coulter, assistant secretary and assistant treasurer.

Production, Sales

Stearmans for Brazil. United Aircraft increases wages

THE Brazilian Army Aviation Department signed a contract late in October with the Stearman Aircraft Company, of Wichita, Kansas. The contract calls for 30 Stearman Model 76-C3 advanced trainers. Power will be from Wright Whirlwinds of 420 hp. The purchase price is $585,000, and the first lot of five planes will be delivered next March.

One of Lockheed's new Model 12s (see AVIATION for September, 1936) which won the Bureau of Air Commerce competition for a small two motored transport for feeder-line service, has just been delivered to the Bureau for the use of Department personnel. The plane cruises at 213 m.p.h. on the power from two Pratt & Whitney Wasp Juniors. It is equipped with a Sperry Gyropilot, Western Electric two-way radio, and a new Radio Products homing device housed in a transparent pyrolin case and attached to the under side of the fuselage directly ahead of the cockpit. De-icer equipment is installed on the leading edge of the wing and tail surfaces. Fuel tankage for a 1,000 mile range is provided.

Fairchild Aircraft, Ltd., of Canada, has sold 30,000 shares of capital stock to Aldred & Co., Ltd., of Montreal, at $5 a share. The stock was re-offered at $6 a share. Proceeds will be used for working capital to take care of an estimated 100 per cent increase in sales for the year 1936.

As a result of the sale, Fairchild Engine & Airplane Co., which was

LYCOMING STINSON
for missionary work in the northland. Rev. Paul Schulte stands on the float of the plane he has donated to tie together the far-flung outposts of Canada.

was formed in October to separate the airplane and engine manufacturing activities of Fairchild Aviation Corp. from its camera and instrument divisions, will have its stock interest in the Canadian company reduced to about 37 per cent from 49½ per cent.

Effective November 17, all divisions of United Aircraft Corporation granted a flat wage increase of five cents an hour for their hourly wage employees. This will add more than $635,000 to the corporation's annual payroll. The Board of Directors also voted a 50 cents per share dividend, payable Dec. 15, to stockholders of record Dec. 1. On the basis of 2,503,783 shares outstanding, this would mean a $1,251,891 dividend distribution.

New York and New England distributorship for the 1937 series of Ryan S-T planes, produced at the Ryan Aeronautical Co. plant at San Diego, has been granted O. J. Whitney, Inc., North Beach Airport, New York. On a recent trip to the West Coast factory, Whitney ordered five planes, three of which were for immediate delivery.

Ryan recently decided to finance plane sales on the basis of one third purchase price down, and the balance in twelve monthly installments.

The Ex-Cell-O Aircraft & Tool Corp., Detroit, Mich., has adopted a group insurance program providing approximately 900 employees with sickness and accident benefits, and a total of nearly $900,000 of accidental death and dismemberment protection.

Taylor Aircraft Co., of Bradford, Pa., has announced a $200 reduction in the price of the Taylor "Cub," bringing the price down to $1,270. W. T. Piper, general manager of the Taylor Aircraft Co., has estimated that the plant has a 2,500 plane capacity for next year. Since January of this year, available floor space and number of employees at the plant have been tripled.

The Stearman-Hammond Aircraft Corp., which has been organized to manufacture the Hammond Y pusher developed for the Bureau of Air Commerce light plane competition, has registered 280,000 shares of common

COL. LINDBERGH *Wide World*
discusses his new Miles Mohawk with its designer, Frederick George Miles. The plane was designed to the Colonel's specifications, and is powered with a 200 hp. supercharged Menasco inverted engine (B-68).

BRAZILIAN PILOTS WILL TRAIN

In these Stearman Model 76-C3 advanced trainers, 30 of which have been ordered from the Stearman Aircraft Company. Power comes from Wright 420 hp. engines.

stock on the San Francisco Curb exchange. The company is headed by Lloyd Stearman, and has constructed a new plant adjoining the San Francisco Municipal Airport. Fifteen Ys have been contracted for by the Bureau of Air Commerce.

Walter Kidde & Co., Inc., has developed a new improved valve for Lux airplane fire extinguishing systems allowing a weight reduction of approximately 12 per cent. Weight of single motor local control installations is now down to about 15 lb.

The Security National Aircraft Corp., headed by W. B. Kinner, is planning construction of a factory adjoining the Long Beach Municipal Airport. It is planned to put into production a two place low wing monoplane powered with a 125 hp. Kinner (see page 35). The schedule calls for an initial program of two planes a week.

Grumman Aircraft Engineering Corporation, of Farmingdale, N. Y., has acquired non-exclusive rights to a landing gear patent developed by the Grover Loening Aircraft Co. The gear is the type in which the main strength strut consists of two legs joined by an offset self locking hinge, and one leg of which is a shock absorber.

Major Alexander P. de Seversky, president of the Seversky Aircraft Corp., announced in October the purchase of the plant which the Ranger Engineering Corp. was leasing from the Aviation Corp. Sherman M. Fairchild (Ranger is a Fairchild subsidiary) denied this, stating that Ranger held an option on the property, which it intended to exercise. There, for a week, the matter was deadlocked. Then last month the two companies announced a settlement of the dispute: each will buy from Aviation Corp. its present plant, and will use the adjacent field jointly.

The Canadian Car & Foundry Co., which in October announced that it had acquired export license rights to the Grumman FF1 two-seater fighter, will also handle export manufacture and sales of Vincent Burnelli's transport monoplane. Sales efforts will be made in Canada, England and South America. Last month a picture caption in AVIATION gave the plant a capacity of fifteen planes a day. This should have read fifteen planes a week, as it was in the accompanying story.

Fare Enough

Two lines join TWA in cutting prices.

IN THE last ten years, passenger fares per mile on U. S. airlines have come down more than 50 per cent—from 12 cents in 1926 to 5.7 cents in 1935. This has been the result of growing traffic volume, more efficient equipment, and ever-increasing competition. For the past four years, fares have more or less crystalized, the movement downward having been less than half a cent since 1932.

Then Sept. 28 TWA announced drastic fare reductions as an inducement to traffic through the winter months when it usually slacks off. The TWA philosophy is that it's more economical to fill their planes at less per passenger than to operate with a lower load factor because of higher fares.

Almost immediately after the TWA announcement there was talk of an impending rate war among the airlines. But one after another the other three of the "Big Four," American, Eastern and United, disclaimed all thought of participation in a war. Eddie Rickenbacker, general manager of Eastern Air, said "There is no such thing as 'cut rate' air transportation. . . . For ten years now air lines . . . have fought courageously . . . to place air transportation in this country where it is today. Now, when air lines are beginning to show black instead of red on their books, is the time for those men who have stuck to their posts during this hectic ten year struggle, to get their rewards. . . . To indulge now in a childish price war would be to knock the props right out from under this factor of reward toward which we have been so laboriously reaching for ten years."

A few days after TWA's announcement of fare cuts, Chicago & Southern Air Lines announced "substantial fare reductions . . . in line with the recent action of TWA." Carleton Putnam, C & S president, believes that "the time has passed for regarding air travel as a service available only to the few. . . . We believe the increased traffic volume which will result will not only increase company revenues, but will widen the usefulness of our service."

Third line to reduce fares was Braniff Airways, which instituted lower winter rates effective until March 1 of next year.

Meanwhile, before Braniff came into the picture, C. R. Smith, energetic young president of American Airlines, also declined to get on the bandwagon. His point was that "members of the industry flying 80 per cent of the passenger miles of the country are not putting cut rates into effect." But he added, "We will watch with interest how the public likes cut rates in air transportation."

W. A. Patterson, president of United Air Lines, held that "United is reciprocating the public's approval of its present rates, policies and service, which have enabled it, without cutting rates, to operate at the highest load factor in its history."

Calendar

Dec. 10-11-12—Ninth Annual All American Air Maneuvers, Municipal Airport, Miami, Fla.

Jan. 28-Feb. 6, 1937—National Aircraft Show, Grand Central Palace, New York.

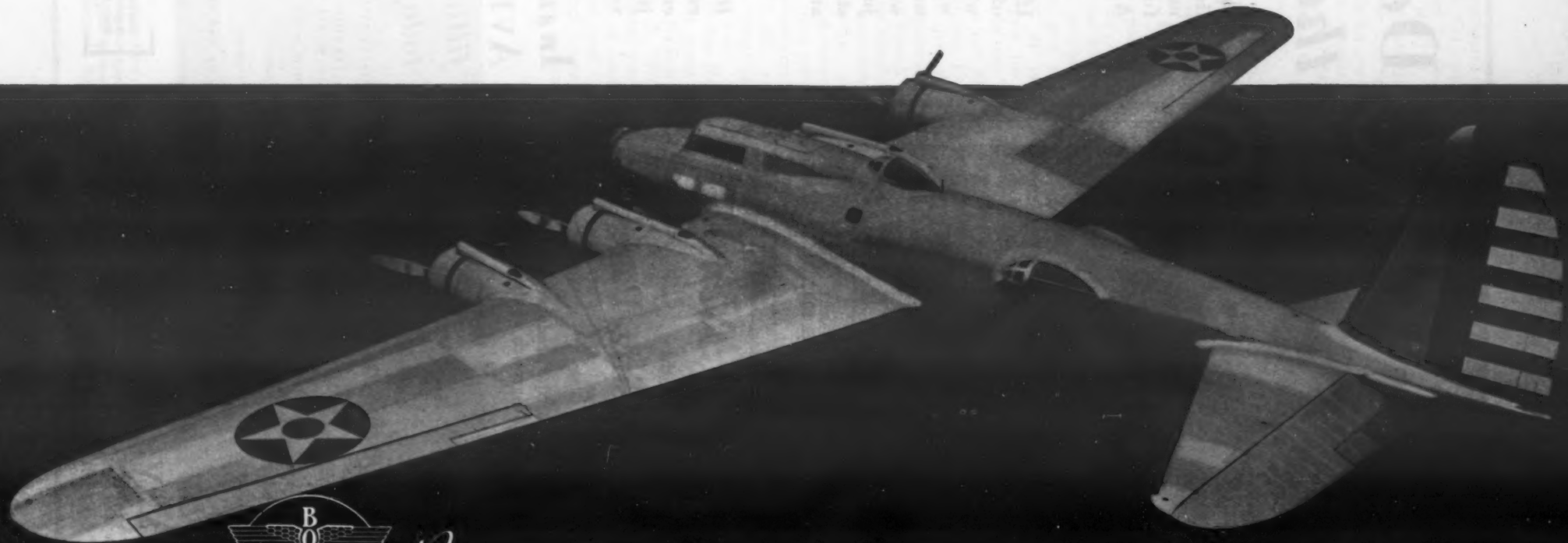
March 13-21, 1937—Second Annual Pacific Aircraft Show, Pan-Pacific Auditorium, Los Angeles, Cal.

Sept. 12-16, 1938—Fifth International Congress of Applied Mechanics, Cambridge, Mass.

NEW WINGS FOR DEFENSE...

★ Pioneering is a Boeing tradition. This is the first of a series of giant four-engined bombers now being built for the United States Army Air Corps, a type of plane which is establishing a new trend in commercial as well as military designs.

The Boeing YB-17



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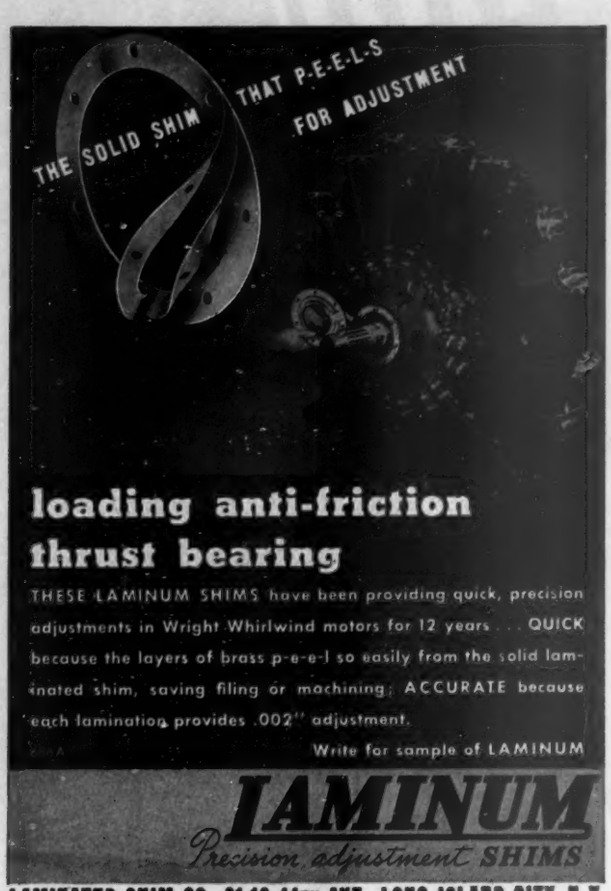
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Miami Cruise

Two light-plane groups planning mass flights to annual maneuvers

A pre-race feature of the Ninth Annual All American Air Maneuvers, to be held at Miami, Fla., on Dec. 10, 11, and 12, will be the arrival at the municipal airport of two large groups of light planes. The Taylor Aircraft Co., of Bradford, Pa., is sponsoring a mass flight of Taylor Cubs, which is scheduled to leave Atlanta on Dec. 7. To date 39 ships are signed up. The Taylor Company will pay each member's room accommodations for the four nights he will be in Miami. This "Cub Convoy" is under the direction of Ted Weld, of Taylor, Maj. D. H. Young, Pure Oil Co., and Ralph Lockwood, Gulf Oil Co.

A second group of planes, which may range in size from 30 to 50, will be made up of Aeroncas, and will leave Cincinnati, O., Dec. 6. The Aeronautical Corporation of America, which is sponsoring the event, will supply gasoline to all entrants who stay with the cruise through to Miami. Every Aeronca owner east of the Mississippi has been invited to join.

Procurement

Army orders 267 planes. 66 Consolidated VPBs for Navy

The Army Oct. 26 announced award of a contract for 117 basic trainers to the North American Aviation Corporation, Inglewood, Cal. Contract price is $1,432,600. The planes will be detailed for use at the Air Corps Primary Training School at Randolph Field, Tex. The Air Corps said that "although somewhat slower, this plane is very similar in appearance and general handling characteristics to the modern pursuit planes, and at the same time has the ease of maintenance, combined with sturdiness of construction which is required in a training plane."

Oct. 30 came another basic trainer order, to the Stearman Aircraft Co. The contract calls for 30, at a price of about $450,000.

A second large order to North American came Nov. 19, and called for 120 observation planes. The ships are three-place midwing monoplanes with retractable landing gears and tail wheels. They will be powered with single 850 hp. Wright Cyclones, and will be equipped with trailing edge flaps. Purchase price is $3,429,600. Secretary of War Harry H. Woodring said, in announcing the award, that the contract practically completed the procurement program under the 1936-37 appropriation. By the end of this year, he expected to complete a program for the acquisition of 500 planes.

Consolidated Aircraft Corp., San Diego, Cal., was awarded a $6,056,500 contract for 66 patrol bombers for the Navy Nov. 17.

The Coast Guard has asked for bids on from two to six monoplanes, convertible for use either on land or water.

In a circular dated Oct. 30, the Air Corps asked for bids on 40,505,000 gal. of gasoline, on several separate specifications.

Traffic Gains

Reports from American, Eastern, TWA, United, show new records

THE report issued by C. R. Smith, American Airlines' president, for the first nine months of this year, showed a 31.5 per cent gain for revenue passengers over the same period in 1935. Number of passengers—175,549—was the largest for a similar period ever carried by any U. S. airline. It came within a few hundred of the total for the full year 1935.

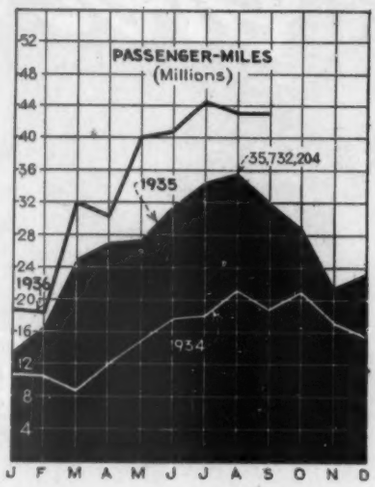
Gains over the same period in 1935 were registered by Eastern Air Lines in every branch of its operations for the first nine months of this year, according to an announcement by Capt. E. V. Rickenbacker, general manager. Biggest gains were in the air express category, which jumped 107 per cent. Revenue passengers increased 21.5 per cent (73,597 this year against 60,581 in 1935), though passenger miles increased 26.3 per cent.

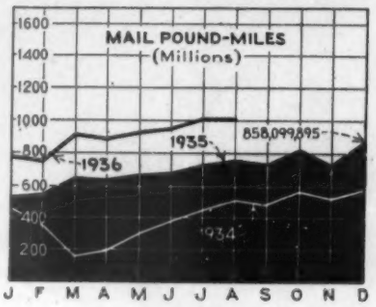
In October Northwest Airlines joined the select group with a ten-year service record. Its first scheduled flight was on October 21, 1926, when the Post Office Department granted a contract for the carriage of mail between Minneapolis, St. Paul, and Chicago.

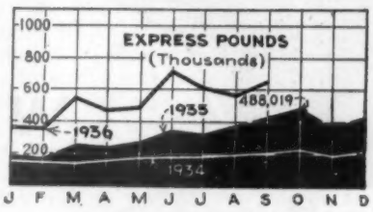
Braniff Airways attorneys have withdrawn an application filed with the Post

Traffic

Latest available statistics from the Bureau of Air Commerce and the Post Office Department—Domestic airlines only





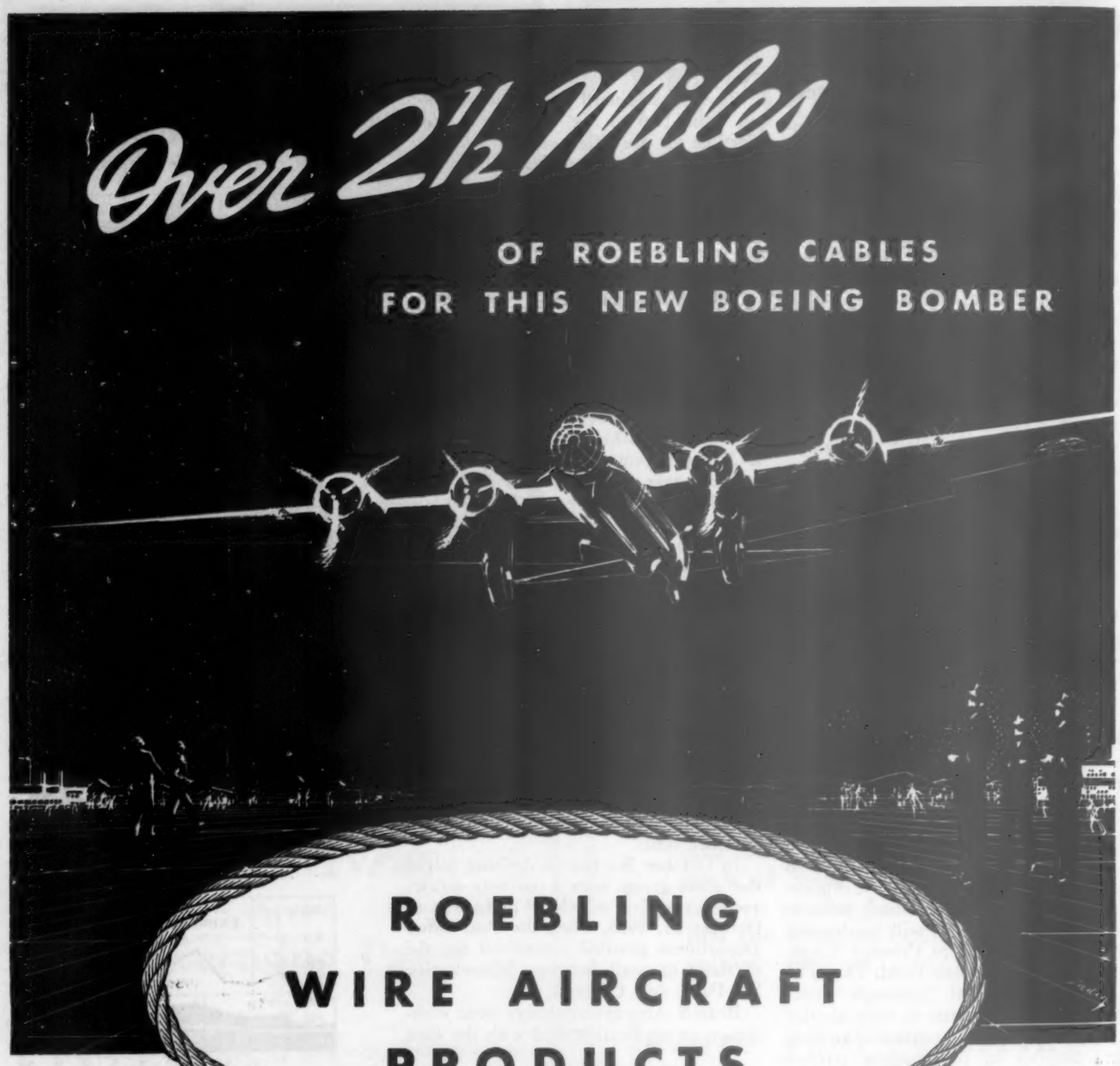


STRIKING POWER

for the Army is inherent in this Boeing bomber. It is the first of thirteen to come from the great new Boeing assembly shops at Seattle, and was pictured just before initial engine tests. Now known as YB-17, it is the same 299 design that flew from Seattle to Dayton last year at an average speed of 232 m.p.h. It is powered with four 1,000 hp. Wright G Cyclones.

Over 2½ Miles

OF ROEBLING CABLES FOR THIS NEW BOEING BOMBER



Boeing YB-17 Bomber for U. S. Army Air Corps.

ROEBLING WIRE AIRCRAFT PRODUCTS

THERE are 2,264 ft. of Roebiing Control Cable and 11,417 ft. of Roebling Electrical Cable used on each of the new Boeing YB-17 Bombers. Thirteen of these giants—America's largest land plane and the world's fastest bomber—will soon be delivered to the U. S. Army Air Corps. ¶ Because they assure the utmost of safety and durability, Roebling Aircraft Cables were the choice for this outstanding fleet as they are for a big majority of planes built in this country.

Roebling Wire Aircraft Products include:—*Tinned Aircraft Wire; 19-wire Aircraft Strand, Tinned or Galvanized; Aircraft Cord (6 x 7, 7 x 7, 7 x 19), Tinned and Galvanized; Ferrules and Thimbles; Serving and Locking Wires; Control Strand and Casing; Power and Lighting Cables; Welding Wire.*

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Office Department for a second hearing in negotiations for the purchase of Braniff by TWA. The first application for purchase was denied. Meanwhile Braniff schedules have been rearranged to make better connections with Pan American at Brownsville and TWA at Kansas City.

Baltimore has been selected as the northern terminus of Pan American Airways for use in the trans-Atlantic survey flights which are scheduled to start next spring. The PAA lease, for ten acres at the Municipal Airport, runs for an initial period of ten years, with renewal privileges for three additional five year periods.

Other Atlantic seaboard cities are still being considered for possible use as terminals—notably Charleston, S. C., and Port Washington, N. Y.

Hanford Airlines is planning installation of light beacons on the route from Omaha to the Twin Cities and from Sioux Falls to Bismarck. Lockheed Electras will be used on the Sioux Falls-Bismarck route.

J. B. Walker, TWA vice-president in charge of traffic, has reported that over the first half of this year each passenger flew an average of slightly over 800 mi., and TWA planes carried 8.39 passengers for each mile flown. Nine-month figures showed a total of 64,875 revenue passengers, compared with 51,745 for the same period last year.

The first nine months of 1936 brought a new record for United Airlines, with traffic gains from 16 per cent to 37 per cent for passengers, mail and express.

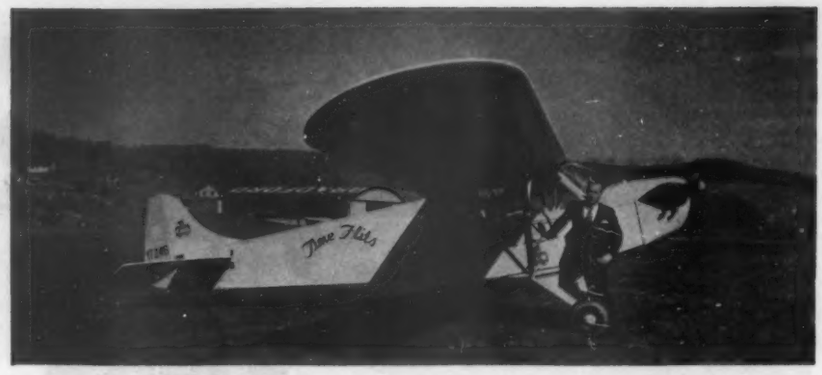
Lockheeds Abroad

British Airways orders four American ships for Stockholm run

PERSISTANT rumors of British purchases of American military planes have been drifting across the Atlantic since early October. Great Britain's plants are known to be loaded up with Air Ministry orders in a frantic rush to build up the air force to a par with Germany and France. On this side of the ocean no confirmation of the rumors could be had, the companies mentioned for possible orders indicating that they were interested, but had heard nothing from England.

Then came information that British Airways, Ltd., had ordered four Lockheed Electras for commercial use. This order was made necessary because the Air Ministry banned use of De Havilland 86A's for night service on the London-Stockholm run, and the state of the British industry did not permit necessary changes in time for inauguration of service.

The Lockheeds will be standard 10-passenger Electras with normal airline equipment. They will be powered with two Pratt & Whitney Wasp Jr. engines, and will be equipped with Hamilton Standard propellers. Delivery dates were not announced, nor was price revealed.



"TIME FLITS,"
a baby companion for Frank Hawks' new speed ship, "Time Flies." It is a Taylor Cub, and here the flier takes delivery at the Bradford plant.

Financial

Many profits reported for nine month and third quarter periods

TEN companies—transport or manufacturing—have reflected the general business upswing by reporting profits in the third quarter or for the full first nine months of the current year.

For the three months ended Sept. 30, Boeing Airplane Company's net profit was reported at $39,289, after charges and normal Federal income taxes. This is equal to 7.5 cents a share on capital stock and outstanding scrip certificates. The same period last year showed a loss of $154,173. For the first nine months of this year, the company had a net profit of $131,712, whereas in the same period last year it suffered a $591,993 loss. These figures include Stearman Aircraft and Boeing Aircraft of Canada, Boeing subsidiaries.

Fairchild Aviation Corporation reports gross sales of its aerial camera, instrument, and aerial survey subsidiaries for the nine months ended Sept. 30, amounting to $721,316; net profit, after parent company expenses but before provision for taxes, amounted to $33,488, and unfilled orders were $977,254. Fairchild Aircraft, Ltd., the Canadian subsidiary reported a net loss of $9,214 for the ten months ended Oct. 31.

A net income of $513,525 has just been reported by Imperial Airways for the year ended last March 31.

Directors of Standard Oil (Indiana) Nov. 6 declared a regular dividend of 25 cents and an extra dividend of $1, payable Dec. 15 to stockholders of record Nov. 16.

Net profit of the Aviation Corporation for the third quarter of 1936 ended Sept. 30 was $58,374. Net loss for the first nine months of the year was $115,896.

The Curtiss-Wright Corporation and subsidiaries have reported net profits for the first nine months of 1936 of $1,262,132. There was a $440,312 profit for the third quarter. Wright Aeronautical, the Curtiss-Wright engine subsidiary, showed a profit of $890,506. For the September quarter, profit was $276,917.

New financing for the Glenn L. Martin Company netted $4,200,000. Unfilled orders of the company on Sept. 30 were estimated at $3,844,000, with gross sales this year at more than $5,000,000.

Earning 22.4 cents a share on 623,135 capital shares outstanding, TWA has reported a net income of $139,880 for the September quarter, the best quarter in the company's history. Directors will offer stockholders the right to subscribe to 207,711 additional shares at the rate of one third share for each share now held. It is expected that this offering will yield between $2,250,000 and $2,500,000, most of which will go for the purchase of new equipment.

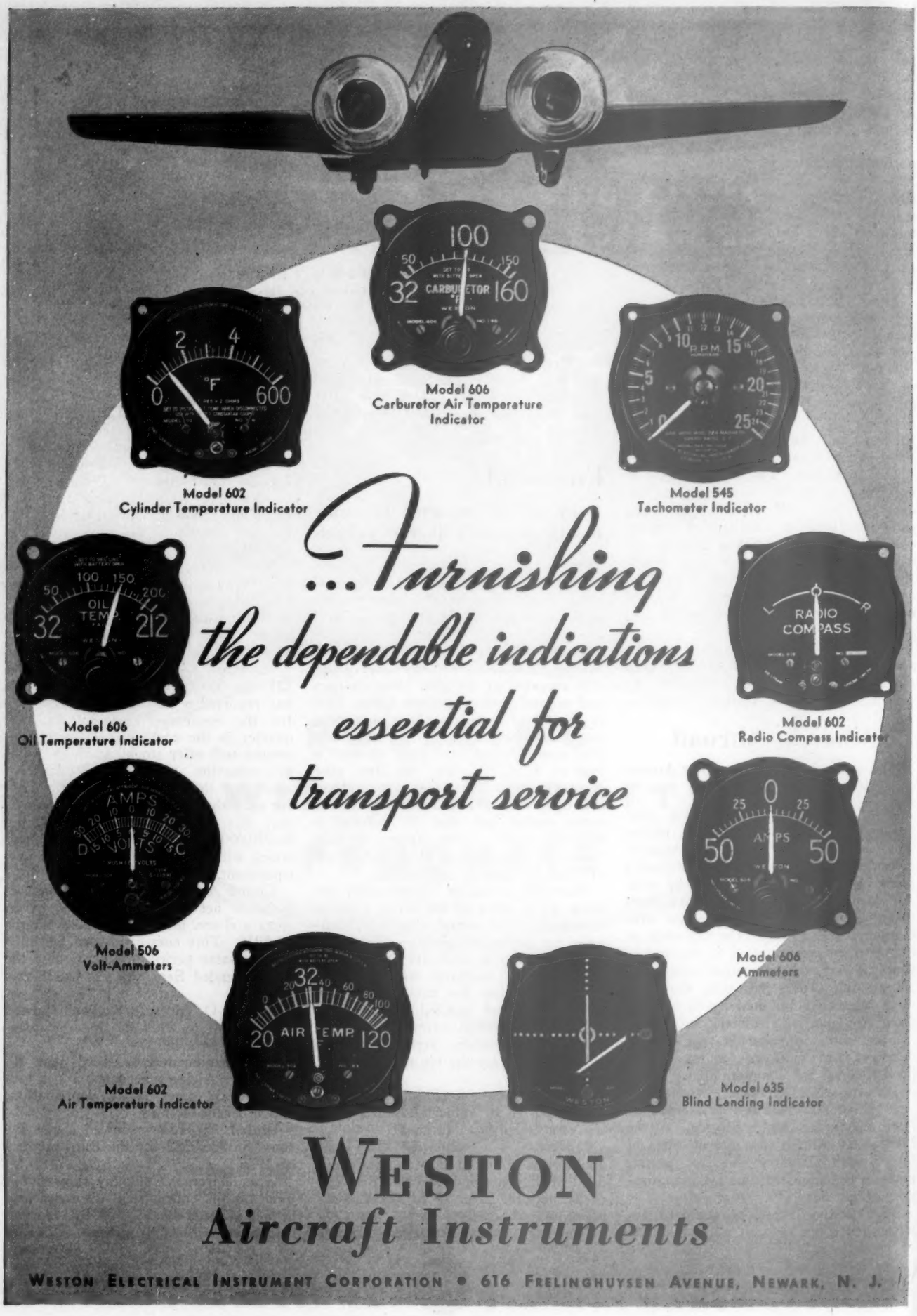
United Aircraft Corporation has reported a net profit of $912,749, or 38 cents a share, for the first nine months of 1936. This compares with $491,313 for the same period last year. For the quarter ended Sept. 30, net profit was $364,189.

Ex-Cell-O Aircraft & Tool showed a net profit of $151,387 for the quarter ended Sept. 30.

For the nine months ended Sept. 30, American Airlines reported a net loss of $296,932 after taxes, depreciation, and other deductions.

United Air Lines showed a net income of $267,582 for the third quarter of 1936.

Waco Aircraft Company showed for nine months ended Sept. 30 a net loss of $40,142 against $13,527 loss a year before: sales $830,081 against, $820,837.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Schools, Services, and Airports

A state-by-state tour of the flying fields

• ALABAMA—Jessie Stallings, commercial operator at the BIRMINGHAM Municipal Airport, is flying with American Airlines as co-pilot between Memphis and Newark. . . . The AUBURN Aero Club, organized at the Alabama Polytechnic Institute at the beginning of the present term, has a membership of 25 students. A Taylor Cub has been purchased and Jack Flood, who received his flight training at Birmingham, is instructor for the club. James Brown is assisting Flood at the AUBURN-OPELIKA Airport. . . . The BIRMINGHAM Aero Club held its monthly meeting and lecture October 8 at the Tutwiler Hotel, Birmingham. Julian Martin, club president, announced he is planning a series of talks by interesting speakers for the club and every member has been urged to be present at the next regular meeting. . . . Work on the ANNISTON Airport's improvement project is scheduled for resumption by the WPA early in October. About $70,000 has been approved for expenditure there, calling for grading, installation of drainage facilities and completion of the administration building and hangar. . . . Work was started early in October on a new $50,000 airport at JASPER.

•ARIZONA—The PHOENIX Flying Club is planning renovation of the club meeting rooms at Phoenix Sky Harbor. Membership in the club has grown to thirty. The newest members are W. M. and Charles A. Tweed and J. Samuels. . . . New wiring for the runway lights at the TWA airport at WINSLOW is being installed under the direction of R. M. Zimmerman. Thirty thousand feet of cable is being used.

• ARKANSAS—The FORT SMITH Kiwanis Club has endorsed a proposal for a bond issue for the purchase and improvement of Fort Smith Airport.

• CALIFORNIA—The first air show in several years was staged at SACRAMENTO Municipal Airport on October 4, sponsored by the Sacramento Junior Chamber of Commerce and the local chapter of the National Aeronautic Association. Participation was principally by local commercial and private pilots and the well organized program and good publicity brought out one of the biggest crowds since the dedication, estimated at close to 25,000 persons. The program included a parachute jump by Gordy Baugh, races, a bomb dropping contest, and stunt flying. . . . C. T. Jensen, who operates a crop dusting service from SACRAMENTO Airport reports the purchase of a Challenger Travelair from Derel Weston of WOODLAND, and the rebuilding of his Romair. . . . Walter Browne has had a busy season of charter work with his Fairchild at SACRAMENTO Municipal Airport. . . . Dr. D. W. Babcock, PLACERVILLE, has purchased a new Waco cabin. . . . Two air marking signs, showing the way to the MODESTO Municipal Airport, are being painted. . . . Ben Torrey announced that 40 planes and 60 flyers were scheduled to participate in an air show at the CORNING Airport late in October. . . . LONG BEACH city officials are planning the dedication of the Long Beach Municipal Airport, on which more than $260,000 has been spent in the past eighteen months. . . . M. H. Carberry has leased the BRAWLEY airport for three years. He will erect a machine shop and operate the service concession. Fifteen new members were admitted into the STANFORD Flying Club at a meeting Oct. 8 at the PALO ALTO Airport. . . . A new 4,000 ft. runway was opened at SAN FRANCISCO Municipal Airport on Oct. 14. It is the first step in a $3,000,000 program to improve the field. . . . The SAN JOSE State Flying Club is planning the purchase of a Taylor Cub. Frank Petersen will be club reporter. . . . The TURLOCK City Council is considering the establishment of a municipal airport. . . . REDDING has appropriated $6,000 for the extension of the north-south runway at Redding Municipal Airport.

• CONNECTICUT—The fifth annual air show commemorating the anniversary of the opening of the NEW HAVEN Municipal Airport was held Oct. 11. Over 60,000 spectators were present. Performers included Pete Brooks, Luis de Florez, Johnny Runger and Tom Lockhart. . . . A crowd of 10,000 witnessed the BRIDGEPORT centennial air show at Mollison Airport, STRATFORD, Oct. 18. The show was sponsored by the Bridgeport Flying Club under the directorship of Dr. Joseph L. Levy and James Malarky. Thomas Ray and Constant Moeller of New Haven won the drawing. George Arents of Boston won the 15 mile race.

• DISTRICT OF COLUMBIA—Construction of approximately 100,000 sq.yd. of paved runway, taxi strip and apron at Washington Airport is now under way. As a safeguard against possible accident during the construction work, Washington Airport officials have installed a zoned system of radio control for all landings and take-offs. It is considered possible that the system may be made permanent. Zoned charts are being issued to pilots using the port regularly. Pilots are required

TAYLORCRAFT

heads: Kenneth Tibbits (left) production manager, and C. G. Taylor, president of Taylorcraft, inspect the engine of the newcomer in the light plane field.

to contact the control tower before landing. The tower indicates areas available for landing. The control is in operation 24 hours a day.

• FLORIDA—The field lighting installed by the WPA at FORT PIERCE Airport was ready for use Sept. 22. The current is furnished by the city and the three long runways are now lighted every night from sunset to sunrise. A new 15x53 ft. metal hangar was completed September 29. . . . The MIAMI City Commission has authorized purchase of the Curtiss-Wright Flying Service hangar at Miami Municipal Airport. Purchase price is set at $20,000.

• GEORGIA—John K. Ottley, Jr., chairman of the aviation committee of the ATLANTA Chamber of Commerce has announced that another Georgia air treasure hunt will be staged in 1937. This year's tour saw more than 1,000 landings and take-offs and covered 28,000 miles. It was sponsored as an advertising scheme for Georgia industries. . . . Southern Airways, Inc., will lease the AUGUSTA Municipal Airport for a 5-year term, if the City Council gives its approval. . . . SAVANNAH is seeking additional lighting facilities at the Savannah Municipal Airport. . . . MACON's new airport was dedicated late in September. . . . Work was scheduled to start early in October on the first runway at the new GLYNN COUNTY Airport on ST. SIMONS ISLAND. The runway will be 1,500 ft. long and 100 ft. wide.

• IDAHO—A radio range beacon is being installed at the POCATELLO Municipal Airport. . . A WPA expenditure of $40,000 has been approved for construction of airplane shops and a hangar at the University of Idaho, Southern Branch, POCATELLO.

• ILLINOIS—An air marker 508 ft. long has been completed by WPA workers at MARION Airport. . . . The southwest-northeast runway at MOLINE Municipal Airport was finished early in October. . . . Presidential approval has been given to a $172,000 WPA project for the improvement of the BLOOMINGTON Municipal Airport. . . . A crowd of more than 2,000 people attended an air show held early in October at the MOMENCE Airport. The meet was managed by John Brown.

• INDIANA—An air show staged by the SOUTH BEND Pilots' Club early in October netted the club a profit of $125. . . . A $51,000 WPA project is under way at ROCHESTER Municipal Airport. Plans call for an 80x100 ft. hangar with a 20x100 ft. lean-to across the south end. The city is contributing $4,000 of the total funds. . . . An air show was scheduled at the PLYMOUTH Airport late in October.

• IOWA—DES MOINES citizens were scheduled to vote Nov. 3 on a proposed $200,000 bond issue to improve the Des Moines Municipal Airport. The local post of the American Legion has endorsed the plan. . . . A WPA project under way at IOWA CITY will provide reconstruction of the two present runways and construction of a third runway at an approximate cost of $90,000.

• KANSAS—More than 20,000 persons witnessed the air show at WICHITA Airport late in October. The show was held in conjunction with the Kansas Diamond Jubilee Exposition. . . . The GREAT BEND City Council has taken initial steps toward the purchase of ground for a municipal airport.

• KENTUCKY—Major John C. Bennett, Jr., president of LOUISVILLE Flying Service has announced the appointment of Richard A. Daniel as sales manager. The Louisville Flying Service is distributor for several planes in the Louisville area and also does charter work and conducts a flying school. . . . Seven planes are basing at the PADUCAH Municipal Airport. This fills the new WPA hangar to capacity. Planes at the field are owned by J. D. Payne, Jack Hixson, Dick DaVania, E. W. Sowell and Holland G. Bryan.

• LOUISIANA—A new airport serving both RODESSA and VIVIAN was opened early in October. It was named Viv-Ro Airport. . . . The NEW ORLEANS Aviation Club held a flying meet at Shushan Airport late in October as part of the observance of National Air Progress Week. The spot landing contest was won by Augusta Walmsley. She competed in a field of six, including Miss Margaret Lamonte, C. E. Fellon, Lloyd Moreau, John Stahler, Wallace Jumonville, and Dan Louis.

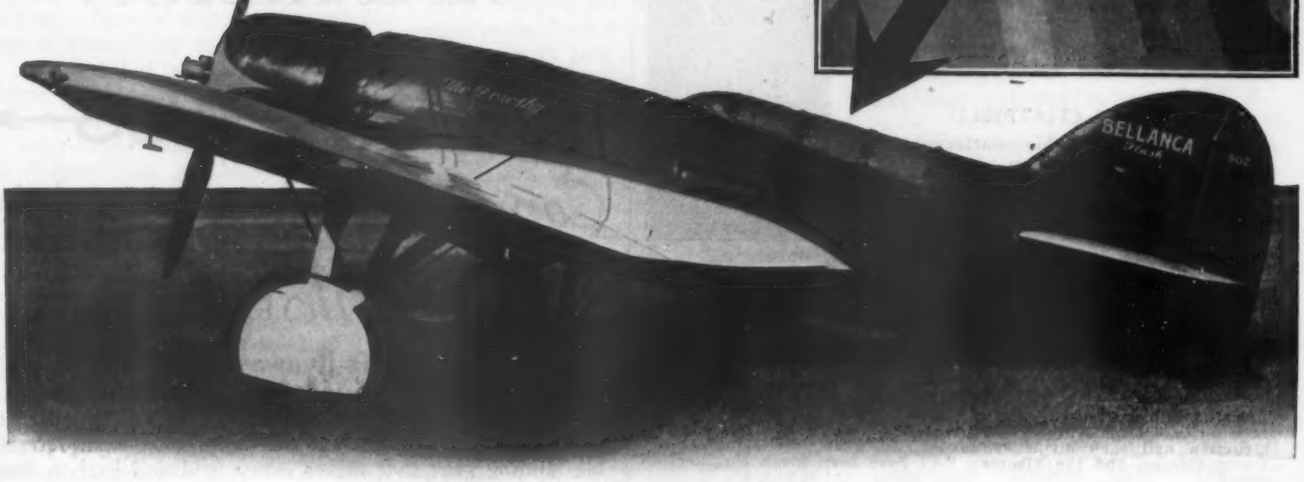
• MAINE—A new company, Maine Airways Corporation, has been organized at BANGOR. Operating a Stinson, the company will offer charter service throughout northern and eastern Maine. Headquarters is at the Bangor Airport. Officers of the company are: Stuart H. Mosher, president, Jack S. Atwood, treasurer, and Mosher, Atwood and James M. Gillin, directors. Chief pilot will be Randolph A. Mulherin. . . . High tension line towers of the Central Maine Power Company over the Kennebec River at BROWN'S ISLAND are being painted orange and white so that they may be more easily seen in bad weather. . . . BANGOR is planning erection of radio range beacon towers at the Bangor Airport. . . . The northeast-southwest runway and the southeast-northwest runway at the AUGUSTA State Airport have been completed. Two more runways are under way as a WPA project. No. 1 runway is 3,200 ft. long. Plans are under way for the removal of an old National Guard storage building standing on the eastern side of the southwesterly portion of the runway. More than 400,000 cu.yd. of earth have been moved under the improvement program. . . . The PORTLAND Flying Service will construct a new 60-ft. hangar to provide space for new planes, according to Harold F. Troxel, president. . . . The Island Crop Dusting Co. has been formed at CARIBOU, where it has leased the Caribou Airport from Mike Corey. Seth Yerrington is president and Ernest Pretsch is treasurer.

T. CLAUDE RYAN

delivers one of his well-known Ryan S-T-As to Bettie Lund, who will use it for acrobatic work. The scene is the Ryan Aeronautical Co., San Diego.

PLEXIGLAS

Crosses the Atlantic



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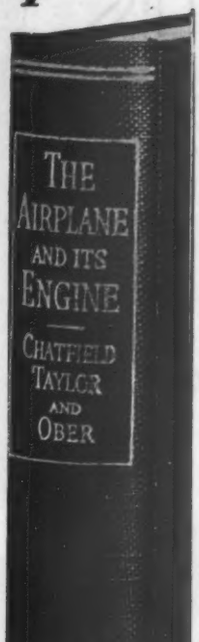

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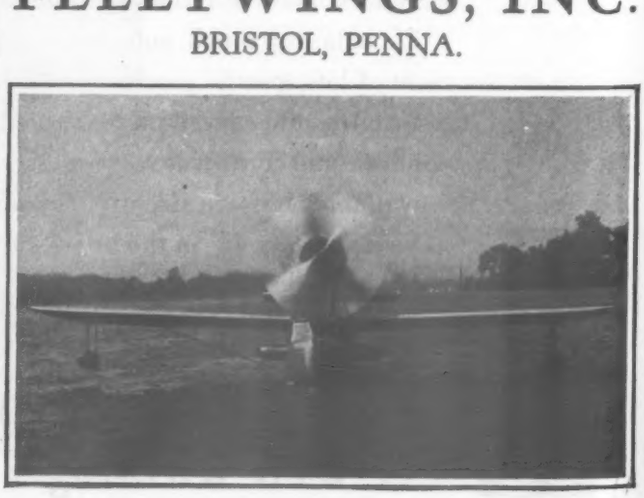

• MARYLAND—The Aviation Committee of the CUMBERLAND Chamber of Commerce is seeking to speed action toward obtaining a new airport so that WPA assistance may be sought. . . . A $117,000 WPA improvement project has been approved for HAGERSTOWN Airport. Plans call for two concrete runways, field lighting and a 100x100 ft. hangar. Work started late in October.

• MASSACHUSETTS—E. W. Wiggins Airways, operating at the BOSTON Metropolitan Airport, reports the sale of two new Taylor Cubs. . . . The Aviation Club of BROCKTON conducted an air meet Oct. 11 and 12 at the Brockton Airport. A large crowd witnessed the events, which included bomb dropping, paper strafing and balloon bursting. Howard Brooks gave exhibitions of stunt flying in a Fleet Trainer. . . . Donald LaClaire, manager of the Westwood Airport at WESTWOOD, reports the sale of a Stinson cabin plane. . . . Inter-City Airlines, BOSTON Municipal Airport, has purchased a second Ranger powered Fairchild within a four-week period. Robert M. Love, president of Inter-City, flew the new ship to Boston from the factory at Hagerstown. A two-place 1936 Rearwin Sportster was added to the Inter-City fleet during the first week of October. . . . The ninth anniversary of the opening of the GRAFTON Airport was observed late in October with several thousand spectators watching a stunting exhibition and a parachute jump by William Picune. . . . Late in September the Barnes Municipal Airport, at WESTFIELD, was dedicated. The program was sponsored by the Westfield Chamber of Commerce in conjunction with the National Aeronautic Association and the Boston Aero Club. . . . The New England Regional Planning Commission has drawn up a comprehensive plan for the development of existing and suggested airways in the New England area. . . . A $34,000 WPA fund has been set aside for work at EAST TAUNTON Airport if the city acquires title to the land.

• MICHIGAN—BATTLE CREEK City Commission has rejected a proposal of the Kellogg Airport Advisory Committee to establish an administrative board with authority to conduct the affairs of the field. Management of the airport will be vested, as heretofore, in the city commission. A resolution has been passed approving an agreement with the Gulf Refining Co. for maintenance of gasoline service equipment at the field. . . . . City Manager W. K. Willman, of MOUNT PLEASANT, is seeking a site for a joint airport to be managed by the city and ISABELLA COUNTY. An appropriation was made by the city and the county several months ago, but so far negotiations for a site have failed. . . . The KALAMAZOO Junior Chamber of Commerce sponsored an air show at Lindbergh Field early in October. More than 2,000 spectators turned out. Russell Carnes won the 15 mile closed circuit race and a silver cup. Charles Connor won the acrobatic contest. . . . A group of State and WPA officials made an air tour of airports on the upper peninsula early in October seeking new sites for landing fields. . . . The WPA project calling for surfacing of the ends of two of the three runways at Bishop Airport, FLINT, was scheduled to start early in October. The runway work is part of a $78,000 improvement project. The runways have been lengthened 350 ft. and are now 2,600 ft. and 2,800 ft. long. . . . WPA workers are leveling three runways at the Ford Airport in KINGSFORD. The work is part of a $15,900 WPA project. . . . Clyde Cole, manager of the Bishop Airport, FLINT, has announced that two new floodlights have been installed on the roof of the main hangar. . . . The Joyce Hartung Trophy, sponsored by Howard Hartung of the Aeronautical Activities Association, was won by Mrs. Dorothy Carpenter at Gratiot Airport, DETROIT, late in October. It was a woman's trophy competed for in a balloon bursting, bomb dropping and spot landing contest.

• MINNESOTA—The BEMIDJI Junior Chamber of Commerce is seeking WPA assistance for construction of a hangar at the municipal airport. The project is estimated to cost about $4,000, the sponsors' share being $1,700. . . . Two of the three concrete runways at Wold-Chamberlain Field, Minneapolis, were completed early in October, and the third was scheduled for completion in a few weeks. . . . Minnesota chapters of the National Aeronautic Association sponsored a convention at ST. PAUL late in October.

• MISSISSIPPI—An expenditure of $31,000 on improvements at the GREENWOOD Municipal Airport has been authorized by the WPA. Under the project the runways will be lengthened and widened, position of the boundary lights will be changed and a steel hangar and work shop will be erected. . . . With the approval of a $300,000 WPA project, city officials of JACKSON have announced that the proposed $480,000 improvement program proposed for the municipal airport would begin in the near future, with work expected to be completed by the first of next March. Plans call for grading and asphalting all runways and completion of the new administration building, which was started early in the summer. . . . Nine Army planes, several nationally known flyers and the governors of Tennessee and Mississippi were present Oct. 13 for the dedication of ABERDEEN's airport, the new Eddie Stinson Memorial Airport. The field was built at a cost of nearly $100,000. . . . Irby Charping of FITLER and R. P. Flanagan, of BELZONI, have purchased Taylor Cubs. . . . TUPELO's new airport, Carroll Cone Field, was dedicated Oct. 14. Col. J. Carroll Cone, assistant director of the Bureau of Air Commerce, made the principal speech. A stunting program and parachute jump were features of the day. . . . A WPA project to enlarge and grade the airport at STARKVILLE got under way early in October. The field is being enlarged from 93 acres to 123 acres.

• MISSOURI — A WPA program calling for expenditure of $150,000 will lengthen runways at Lambert-ST. LOUIS Airport. The east-west runway will be extended 1,300 ft. and the northwest-southeast runway 1,000 ft.

• MONTANA—Fergus C. Fay has been elected president of the newly formed HELENA chapter of the National Aeronautic Association. . . . A WPA project is under way at Harlowton, calling for leveling the field and repairing the hangar. The city recently purchased the land used as a site for the field.

• NEBRASKA—A WPA project to cost between $25,000 and $30,000 will provide the OMAHA airport with new flood and boundary lights. Lighting control will be removed from the south end of the field to an office in the adminstration building. Runways will receive a 2-in. filler of asphaltic concrete and a 1-in. asphaltic top.

• NEVADA—A condemnation suit to obtain 256 acres of land to enlarge the RENO Airport have been filed in the WASHOE COUNTY District Court, after the county commissioners authorized the action. The court will determine purchase price, of which Washoe County will pay $18,000. The balance will be paid by United Air Lines. . . . The WINNEMUCCA City Council has authorized purchase of a 145-acre tract south of the city for development of an airport. The purchase price is set at $1,000.

• NEW HAMPSHIRE—The CONCORD city Work Relief Projects Committee has voted to finance installation of landing lights at the Concord airport as part of a general WPA improvement program. The city will supply $4,000 as sponsor's contribution. Plans call for installation of 30 boundary and runway marker lights and between 25 and 30 obstacle lights. . . . Twelve planes took part in an air show at NASHUA Airport early in October. A stunt flying exhibition was

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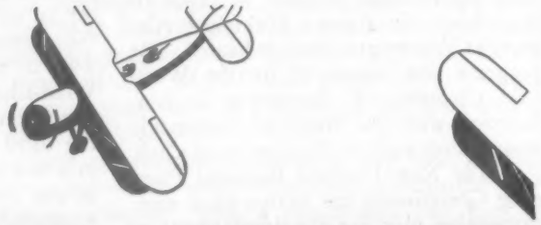

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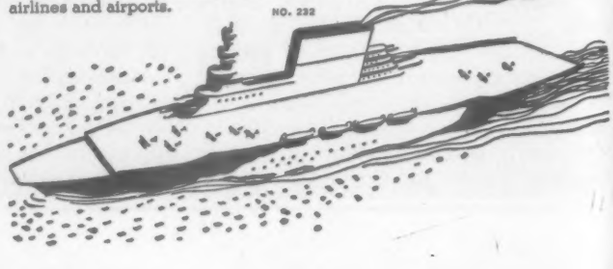

put on by Peter Dana of Holderness in a Ryan, and Arthur Harris of Claremont in an Eagle. The air meet was sponsored by Howard Hartman, manager of the field.

• NEW JERSEY — The southeast-northwest runway at Somerset Hills airport, BASKING RIDGE has been extended 400 ft. . . . Standard Flying Service, Inc., has recently sold a Taylor Cub to S. C. Grady of CHESTER and Ford Herdman of SOUTH ORANGE. . . . The ATLANTIC CITY Flying Club is planning a flying visit to New York to repay a visit made by members of New York's Tailwind Club.

• NEW YORK — Work was started late in October on a new hangar at the SIDNEY Airport. The WPA has furnished about $17,000 and the village will contribute about $1,100. The hangar will be located near the present entrance to the field at the right of the gate. It will be 80x80 ft. . . . Improvement work at Floyd Bennett Field on Miller Hill, GLENS FALLS, was scheduled to start late in October. The Glens Falls Chamber of Commerce has purchased the field and will turn it over to the city. . . . The KINGSTON Airport has been leased by Capt. H. J. Burrows, who will operate a charter service and flying school. Associated with Burrows will be A. E. Ackerly. Burrows now has over 20 active students. . . . Albert G. Wright, Lawrence C. Archer, and Reinhold A. Rubeck, of the AMSTERDAM Flying Service, Inc., have purchased a farm at HILLS CORNERS, where they will establish an airport. . . . According to William Irving, the management of the D-W Airport in LEROY will go to Dr. Harold Trott next April. Trott will sub-lease the field from the present manager, Capt. Russell W. Holderman.

• NORTH CAROLINA—By early October plans had been practically completed for leasing the municipal airport at ELIZABETH CITY to D. J. Driskill, for a period of one year. Driskill will have exclusive use of the field for commercial purposes, but the lease will not interfere with or prevent private use of the airport.

• OHIO—Airways, Inc., of CLEVELAND, has purchased the Fleet trainer from Tommy Metcalf, instructor at Transcontinental Airport, TOLEDO . . . . Erie Isle Airways, PORT CLINTON, has added a sixth plane to its fleet . . . . An air show, witnessed by 5,000, was held at the FINDLAY Airport early in October. Lt. Joseph C. Mackey gave an exhibition of stunt flying . . . . 15 pilots from CINCINNATI, TROY, DAYTON, MIDDLETOWN and COVINGTON, KY., took part in a flying contest at Middletown Airport Oct. 12. The contest was sponsored by the Queen City Flying Service, Inc. George Wedekind, manager of Middletown Airport, was host to the group.

• OKLAHOMA — The Hall Brothers Flying Service has been established at IDABEL Airport. It is run by Wiley and William Hall. Flying equipment is a Curtiss-Robin . . . . The Hardy Young Flying Service, OKLAHOMA CITY, has purchased a new cabin Waco . . . . Oklahoma chapters of the National Aeronautic Association were planning a convention at TULSA, November 14-15.

• OREGON — Paving work has been completed on the two 1,000-ft. runways at the PENDLETON Municipal Aiport.

• PENNSYLVANIA — CLEARFIELD is considering establishment of an airport on the Lansberry Farm, 4½ miles east of the town. If the Borough Council approves the plan, WPA assistance will be sought for the site's improvement . . . . WPA has approved an allocation of $199,000 for construction of an airport at MARTINSBURG . . . . Work of applying oil to the runways at the WILLIAMSPORT Municipal Airport at MONTOURSVILLE was started late in October. The project is scheduled for completion by December 15. A second project calling for erection of a hangar and installation of a lighting system has been applied for, but is still awaiting WPA approval.

• RHODE ISLAND — Willard M. Fletcher, Chief of the State Division of Airports, is planning a system of five secondary airports throughout the State. Establishment of fields at WOONSOCKET, BLOCK ISLAND, NARRAGANSETT, WESTERLY and NEWPORT are being considered. Westerly recently turned over a 180 acre tract of land to the State.

• SOUTH CAROLINA—A crowd estimated at 8,000 saw Johnny Crowell win the free-for-all race which climaxed a two-day meeting of the Carolina Aero Club at CHARLESTON, October 18. The spot landing contest was won by Ed Brockenbrough, who also won the ribbon cutting contest. B. P. Parrish, manager of the COLUMBIA Airport, won the light plane race in an Aeronca.

• SOUTH DAKOTA—Work on WATERTOWN's new $67,000 airport, which is being constructed as a WPA project, is expected to be completed this fall. Stonework on the new administration building is finished.

• TENNESSEE—MEMPHIS is seeking WPA assistance for installation of a field lighting system for Memphis Municipal Airport. The estimated cost is $3,508, of which $1,236 will be contributed by WPA . . . . NASHVILLE was planning a dedication air show Nov. 1, signalling completion of work on the new municipal airport.

• TEXAS—Work has started on a WPA runway project at SHERMAN Airport to cost $48,500. WPA will provide $35,312 of the total. Plans call for two runways, one 2,500 ft. long running north and south and another 1,500 ft. running northwest and southeast . . . . Construction work on the new runways at GALVESTON Municipal Airport has started . . . . AMARILLO has submitted to the WPA a request for a $326,000 grant for improvement work at English Airport.

• UTAH — Work was scheduled to start late in October on the SALT LAKE CITY million dollar airport improvement project. The city and county will each apply $75,000 as sponsor's share . . . . The airport improvement project at BRYCE CANYON was scheduled to start

DOUGLAS DF

flying boat being inspected by students of the Curtiss-Wright Technical Institute, Glendale, Cal. The big boat carries 32 passengers.

early in October. The project is being sponsored by GARFIELD COUNTY as a WPA project and will cost about $39,000. Plans call for an 80x80 ft. hangar and two 5,000 ft. runways.

• VERMONT—Nearly 8,000 spectators attended the dedication ceremony at the BARRE-MONTPELIER Airport early in October. The field was improved by the WPA as a joint project by the two cities. It cost about $60,000. Two new runways were constructed . . . . The east-west runway at the BURLINGTON Airport is being extended from 2,500 ft. to 3,800 ft.

• VIRGINIA—An air show, attended by 3,500, was held at Preston Glenn Airport, LYNCHBURG, late in October. Bill McGalliard, flying a Taylor Cub, won the bomb dropping contest . . . . An airport will be established on a 60-acre tract two miles east of BLACKSTONE. Two 2,000 ft. runways will be constructed.

• WASHINGTON—Pasco is seeking a $61,000 WPA appropriation for improvement at the FRANKLIN COUNTY Airport. Plans call for grading and leveling and construction of two runways, one 4,600 ft. long and the other 3,600 ft. long.

Schools

• PARKS AIR COLLEGE at Parks Airport East St. Louis (Ill.) has issued an extensive catalog detailing courses and school equipment. It is generously illustrated with pictures of the shops and the classrooms.

• Because of the large enrollment in the airplane and engine mechanics night school, the ROBERTSON AVIATION SCHOOL, St. Louis (Mo.) announced, through Manager Joseph W. Wecker, start of another such class on October 19. The course deals with the theory of flight, aerodynamics, and maintenance and overhaul of planes and engines.

• Expanding all facilities of the ground school department at the RYAN SCHOOL OF AERONAUTICS, Lindbergh Field, San Diego (Calif.) in order to accommodate the rapid increase in student enrollment, President T. Claude Ryan has announced the following additions to the school faculty: Walter Balch, chief ground school instructor; Virgil McKinley, airplane instructor, and Martin Weidinger, assistant engine instructor. For the second time in the past two months, the Ryan School has been unable to meet the demands from the aircraft industry for trained men. One recent request called for at least 70 Ryan graduates.

• One of the features of the short course in aeronautics which will be part of the program of the School of Adult Education, conducted by the General Extension Division of the University of Florida at OCALA, will be construction of a glider. The course will cover a period of 12 weeks. . . . Unusually large student enrollment is announced by George A. Viehmann, manager of SOMERSET HILLS AIRPORT, at Basking Ridge (N. J.). Seventeen new students have signed up for solo, amateur or private courses since September 15. . . . A. M. ABEL, manager of the Oakland (Calif.) Municipal Airport, has reported an increase in the number of students enrolled in aviation courses at the field—a total of 324 as compared with 275 in 1935. . . . SOUTHERN FLYING SERVICE, INC., Tifton (Ga.) is planning establishment of a flying school. Petitioners for a charter are Frank M. Ward, W. H. Wilson, J. D. Cook, and T. Frank Williams. . . . HARRY CLARK has purchased a new Taylor Cub for use in flying instruction at the Ely (Nev.) Airport. . . . Roger Don Rae has organized a flying school, to be known as CAPITAL CITY AIRWAYS, at Lansing (Mich.). Clayton Jewell is manager of the organization. . . . Clyde Cole, manager of BISHOP AIRPORT, Flint (Mich.) has announced an 18-week course of ground school instruction. . . . CLIVE STANLEY has purchased a Taylor Cub in which to give flying instructions at the Eugene (Ore.) Municipal Airport.

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Design for Production

(*Continued from page* 20)

performance. How much, he asked the world and particularly the transport operators, should the manufacturer sacrifice in performance of economy in the interests of luxury. "On the one hand is the flying box car in which no one will ride; on the other is the Doge's Palace which will not fly. What should the compromise be?" Certainly the airlines must offer comfort at least substantially paralleling the best that its surface competition could present, and the design of chair cushions became only less important than the design of control surfaces.

Mr. Raymond foresaw an unwillingness to continue the use of cold food and paper dishes. Cooking space and more solid utensils would be needed and "the picnic atmosphere will be supplanted by that of the club car." As sleepers became more common to meet a growing demand, the reduction of noise and vibration became more important. The all embracing roar of the exhaust has now been stifled to a point where mechanical squeaks and clicks became annoying. One operator had complained that the snap switches used for the reading lights were too noisy and should be replaced. Reduction of noise had made passenger conversation an annoyance to other passengers. Snoring, too, became highly audible and disturbing, and all who have heard Swanee Taylor's famous discourse on the scientific subdivision of the human snore will agree with Mr. Raymond in his perplexity over how to deal with it. His tentative conclusion appeared to be that it would not be good practice to reduce steady mechanical sounds too far, but Prof. E. G. Reid, of Stanford, in discussion repudiated such defeatism and demanded the closest approach to absolute silence.

For the overcoming of rough air disturbances, Mr. Raymond looked only to flight at high altitudes. That required the supply of oxygen to the cabin, or cabin supercharging. He was content to set the problem before us and to say that it was grave and as yet by no means solved, without attempting at the moment to indicate a solution. There was much to be done, in airplane structure, in power plant development, and in miscellaneous mechanical detail, before "stratospheric" airplanes would emerge from the conversational stage. Active study must go on, but Mr. Raymond thought practical results years in the future.

Discussion of flight luxury always gives the airship advocate his chance, and Dr. von Karman, famed aerodynamicist, seized upon it. The Zeppelin, he said, was in fact the Doge's Palace which nevertheless flew. With its other advantages it provided a freedom of movement which airplanes must yet be greatly enlarged to permit. To a question concerning the importance of passenger vision and the bad effect of the low-wing monoplane in that connection, Mr. Raymond replied with the conviction that few passengers cared particularly, and that in any case the other advantages of the low-wing type overbalanced its disadvantage there. Waldo Waterman said good words for the use of a shock absorbing wing as a means of getting a smoother ride without having to outclimb the bumps. The author replied that so far as shock absorption could be beneficial, the larger ships had the benefit of it inescapably, as their wings necessarily deflected under load more than those of smaller span.

In the course of general discussion at the design session, Mr. Raymond announced very favorable results from the testing of a nose wheel on a Douglas amphibian. He suggested that the nose-wheel landing gear might come to a complete domination of the field and make the present conventional type obsolete, but at least two or three years of testing would yet be needed before matters could go that far.

Aviation People

Who's who and what they are doing

• Up the ladder from pilot to vice-president goes ARTHUR W. STEPHENSON, appointed to that office by National Parks Airways, Inc. His saga starts with flying service during the World War, private air taxi business in 1921, piloting for National Parks Airways since its inception, and latterly manager of operations. In his new capacity, Stephenson will continue as manager of operations for the line.

• Trophy Collectors of the Month: VN Squadron 8D5, COMMANDER ANDREW C. MCFALL,—Herbert Schiff Memorial Trophy, awarded to the Naval Aviation unit with the year's best record of flight without mishap. Hours flown, 4,154, eighty-two units competing. . . . DICK MERRILL,—Eastern Air Lines' Distinguished Service Medal for his round-trip trans-Atlantic flight with HARRY RICHMAN, presented at a dinner dance in his honor in New York. . . . LIEUT. COMMANDER D. W. TOMLINSON (assistant to president Jack Frye of Transcontinental & Western Air),—U. S. Navy's Noel Davis Trophy, on behalf of Squadron VN 17 RD9, the Fleet Reserve Aviation Division rated as most efficient for 1936. The winning crew are all Transcontinental & Western Air pilots. . . . VINCENT BENDIX,—Knight of the Legion of Honor, bestowed upon him by the French government when he was in Paris attending the automobile show. . . . MRS. MADGE MCCLELLAN, widow of MAJOR HEZ MCCLELLAN,—the Distinguished Flying Cross posthumously awarded her husband for his participation in the flight of ten bombers to Alaska two years ago. . . . CAPTAIN FRANK G. IRVIN and CAPTAIN JOHN S. GRIFFITH,—the Distinguished Flying Cross for heroism during a carbon-monoxide test flight at Wright Field which prevented possible loss of life and destruction to government property. . . . LAVERNE R. BIASELL,—Continental Motors Corporation Trophy for the best design of an airplane as part of the junior design course at the University of Detroit. Biasell's design of a low-powered, two-place airplane for sportsman pilot won him a perfect mark of 100 per cent. FRANK BOWERS won second place, JULE PAUKEN, third. Judges were NORMAN TILLY, Continental Motors Corp.; ALLEN DALLS, Stinson Aircraft Corp.; M. A. MILLS, Stout Engineering Laboratories; LT. GLENN G. PRICE, U. S. Naval Reserve; FRANK SPRING, Hudson Motor Car Co.

Arthur W. Stephenson

John H. Shobe

Dick Merrill

D. W. Tomlinson

Thor M. Olson

• THOR M. OLSON has been appointed sales manager of Ex-Cell-O Aircraft & Tool Corporation of Detroit, succeeding WILLIAM F. WISE. Mr. Olson was general manager, later president, of Continental Tool Works until that company was acquired by Ex-Cell-O. He became vice-president and a director after the merger.

• An airplane accident over Syracuse, N. Y. on Nov. 15, brought death to JOHN H. SHOBE, MISS PRISCILLA MURPHY, and HENRY NADEAU. In 1932 Mr. Shobe became associated with F. Arthur Hinchcliffe, prominent Boston automobile man, and set up operations at Boston Municipal Airport. Starting with a Stinson, the business expanded until, in 1935, with five planes based in its hangar, it was incorporated as Shobe Airlines, Inc. with Mr. Shobe as its president. His frequent "mercy" flights earned him a wide reputation. He was a member of the N.A.A., serving as a delegate for Massachusetts at its 1935 convention, also an active member of the Quiet Birdmen and the Aero Club of Boston.

• Moves on the air lines checkerboard: CECIL E. WEST, station manager at Little Rock for American Airlines, became station manager for the line at Los Angeles. DAN MURRELL, radio operator and dispatcher at Little Rock, succeeds him as acting station manager. . . . D. W. RENTZEL, American Airlines' first radio operator at Memphis, has been made chief operator of the line's system. In his new job he supervises routing of radio traffic and the instruction of radio operators. T. J. SANDERS takes his place at Memphis, while JACK DUBOSE, of Glendale, has been appointed his assistant. . . . J. C. THOMPSON was transferred from Eastern Air Lines' Nashville station to Louisville, Ky., as district traffic manager. RICHARD A. DANIELS, his predecessor, has gone with Louisville Flying Service as sales manager. . . . Temporary cessation of plane service at Savannah, due to runway construction, switched Eastern Air Lines' transportation agents JOHN W. DANIEL, JR. and J. F. SHEPPARD, to Charleston and Miami respectively. W. D. BENNETT, local manager, remains in Savannah to look after the company's interest pending resumption of the service. . . . R. R. ROBINSON has been appointed Transcontinental & Western Air's District traffic agent for New York City. He was formerly traffic representative. . . . E. L. ANDERSON, for eight years station manager at Pocatello for National Parks Airways, has been made its assistant dispatcher, with headquarters at Butte. His former job at Pocatello has been temporarily assigned to Wallace Wilson.

• Additions have been made to the engineering staff of Kinner Airplane &

Motor Corp. of Glendale in the persons of H. RICHARD ALEXANDER and STEPHEN ROLLE. Mr. Alexander is engineer in charge of engine design, Mr. Rolle, engineer in charge of engine testing. Both have been doing similar work at the Naval Aircraft Factory at Philadelphia.

• Thiokol Corporation has added JOSEPH CROSBY to its development and sales division. Mr. Crosby comes from the Gutta Percha Rubber Company of Toronto, with whom he had been associated for fifteen years.

• FRANK SCHUBERT, heretofore assistant to the president of Bearings Company of America, has become associated with the management of the Houde Engineering Corporation, a division of Houdaille-Hershey, of Buffalo, N. Y.

• Lockheed Aircraft Corporation's publicity director, RANDALL IRWIN, has been placed in charge of personnel, and is succeeded by JAMES V. GRIFFIN, until now his assistant.

• Pond Crossings: To the States: CAPT. LUTHER Y. P. CHANG, one of China's noted flyers, made a tour of inspection of the GLENN L. MARTIN plant. . . . DR. GIOVANNI P. CASIRAGHI, chief engineer of Tiaggio & Co., DR. LUIGI MARESCALCHI, chief engineer of Ala Littoria, and COL. CARLO PEZZANI, pilot in COL. BALBO's mass flight four years ago, came from Italy to inspect our factories and transport systems. Recent wanderers turn their steps homeward: LESTER D. GARDNER, secretary of the Institute of the Aeronautical Sciences, was feted and dined in England, France, Germany, Italy, and Russia during the course of his aeronautical survey. . . . Having presented his paper before the Lilienthal Gesellschaft fur Luftfahrt Forschung in Berlin, PROF. CLARK B. MILLIKAN stopped off for a visit at the N.A.C.A. Laboratories at Langley Field while on his way to the Coast. . . . DR. GEORGE W. LEWIS is re-established at Washington, fortified with much European aeronauticalia. . . . LT. COMMANDER CLARENCE H. SCHILDHAUER returned from a Clipper trip to the Orient.

From the States: S. PAUL JOHNSTON, editor of AVIATION, sends weekly chapters of what he is seeing on his European visit. . . . LT. COMMANDER B. G. LEIGHTON, vice-president of Wright Aeronautical Corp. called at Honolulu enroute to the Orient. . . . JUAN T. TRIPPE took the Clipper to Hongkong, flew over central and north China before the return trip. . . . J. N. LAURIE of Sidney, Australia, director of Aircraft Limited, and Mrs. Laurie, returned to their homeland after visiting centers of aviation interest here. Mr. Laurie represents the Aviation Equipment & Export Inc., out of New York.

Side Slips

By Robert R. Osborn

THE Post Office Department has ruled that the air lines must accept alligators, terrapin, turtles, lizards, horned toads, frogs and newts as mail passengers, the ruling being based on the assumption that these animals are harmless. We agree that none of these animals are likely to bite one's leg off, but as we have to do occasional traveling with friends who have weaknesses for practical jokes, we hope that the Post Office Department will keep that type of mail off of the sleeper planes.

THE new "roadable"autogiro promises many advantages to the private owner of the future, but it has one serious handicap which probably hasn't been considered by Mr. Pitcairn and his coworkers. Think of the possibility of getting tickets from both the traffic cop and from the Inspector of the Bureau of Air Commerce!

ONE writer, in discussing the future stratosphere transport plane, wonders what the passenger is going to find to occupy his attention, as window space would be limited to a few small port holes and the landscape would be uninteresting even if not obscured by clouds. Our suggestion would be to sign up Gypsy Rose Lee, the Follies "strip tease" dancer, for the stewardess job.

YEARS ago, with a pilot friend who was an Early Bird, we were lolling in the shade of the wing of a field hopping airplane, waiting for a few stray passengers to appear. Our friend had been flying since aviation was a pup and was indulging himself in the privilege of all such veterans in mourning the departed glories of aviation. The high point of his career, apparently, was a barnstorming trip around the country with a wartime Avro, and it seemed that the combination of a dashing aviator with an airplane having a four-bladed propellor had been irresistible for the innkeepers' and farmers' daughters. As we sighed and relaxed in the warmth of his recollections and the summer's day, one of the then new advertising airplanes flew overhead with a banner trailing out behind it and with a siren screaming raucously at us. "There's a good example of what I'm talking about," said our friend, "Who would have thought that I'd live to see the day when an airplane would need a horn to attract attention?"

We thought of our old friend again today as we read of the final blow to the romance of flying—somebody in Southern California is building an airplane which will have a capacity of 2,000 lbs. of fertilizer and which will be used on some of the large western farms! What will become of the thousands of little boys who are going to be pilots when they grow up, when this news reaches them? We predict a wholesale switch in their ambitions to the "G" men or to movie heroes—who could expect to impress *the* girl by stepping jauntily out of a fertilizer plane?

On second thought, perhaps this isn't the "farthest north" for the glamor of aviation. Maybe somebody will design a plane to collect garbage or deliver ice!

WE SEE by the papers that if one becomes a very proficient parachute jumper in the Soviet Union, graduating from a training course which includes jumps into water, jumps with rifle, gas mask and skis, and finally delayed jumps, one is eligible for the Order of the Red Star. This decoration permits the wearer to travel free by rail or water anywhere in the Soviet Union once a year, fifteen roubles a month in cash, free street car transportation, relief from taxes of any nature, and a 10 to 50 per cent reduction in rent. We wish our government would establish some such system of training over here; we've always wanted to ride free on the street cars. Even with the promise of "relief from taxes of any nature" we are sure it wouldn't disturb Mr. Roosevelt's budget figures at all, if he offered that parachute jumping course to the "economic royalists" or Liberty Leaguers in this country. If these classifications would include Mr. Morgan, we are sure he'd rather continued holding midgets on his lap during senatorial investigations.